October 1981
vol 7, no 10
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creative computing

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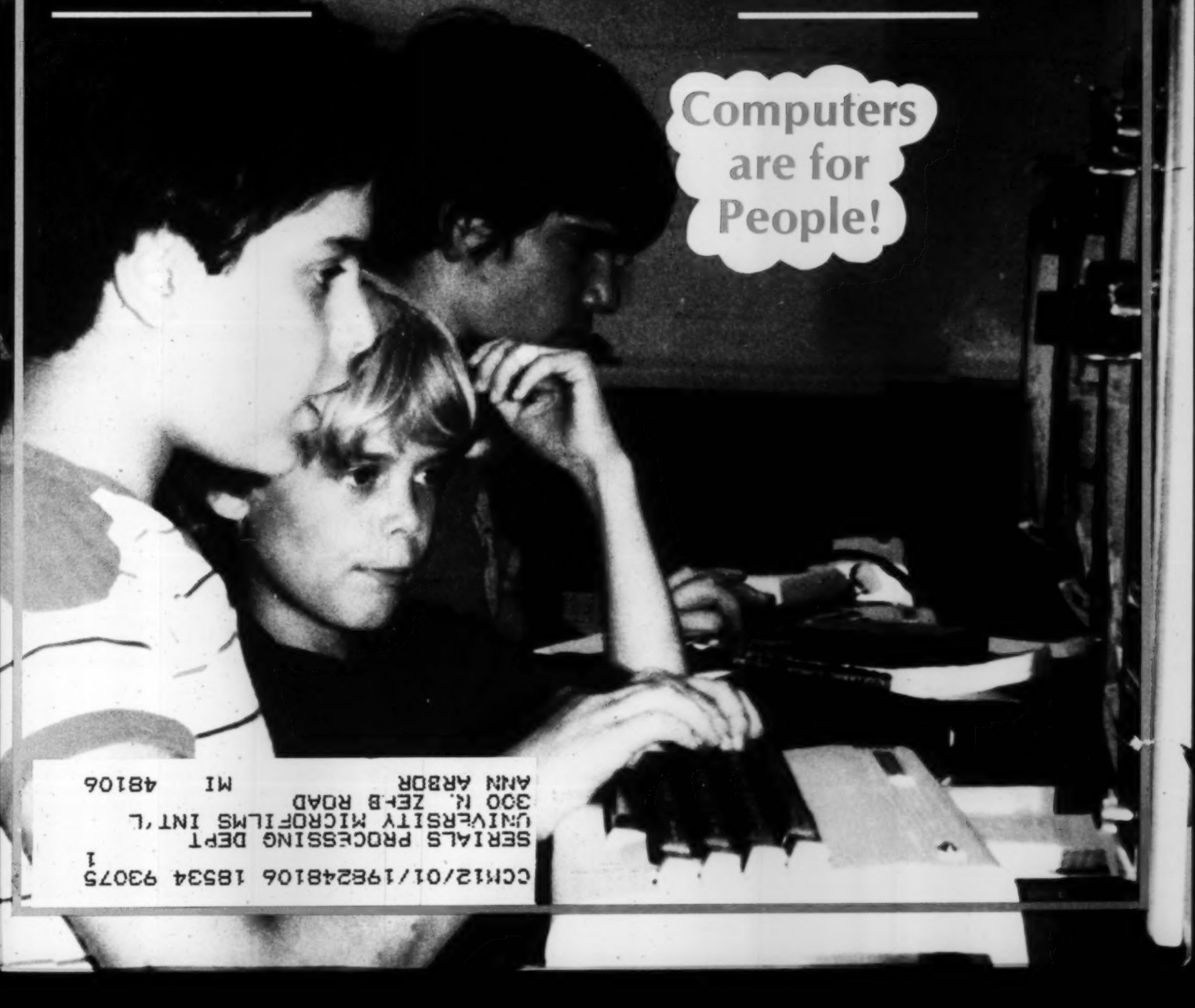

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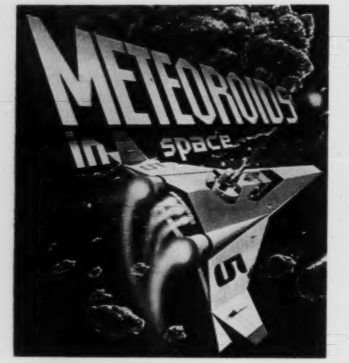

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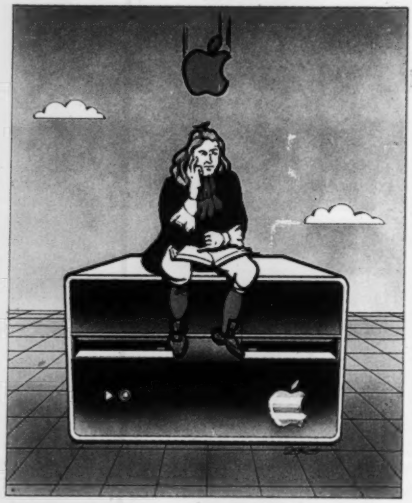

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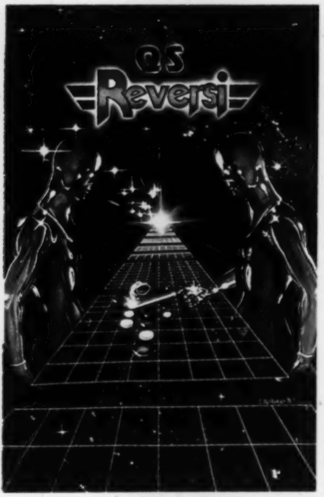

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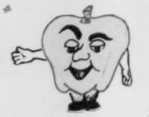

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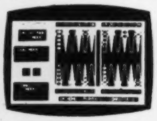

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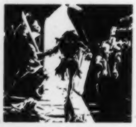

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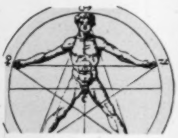

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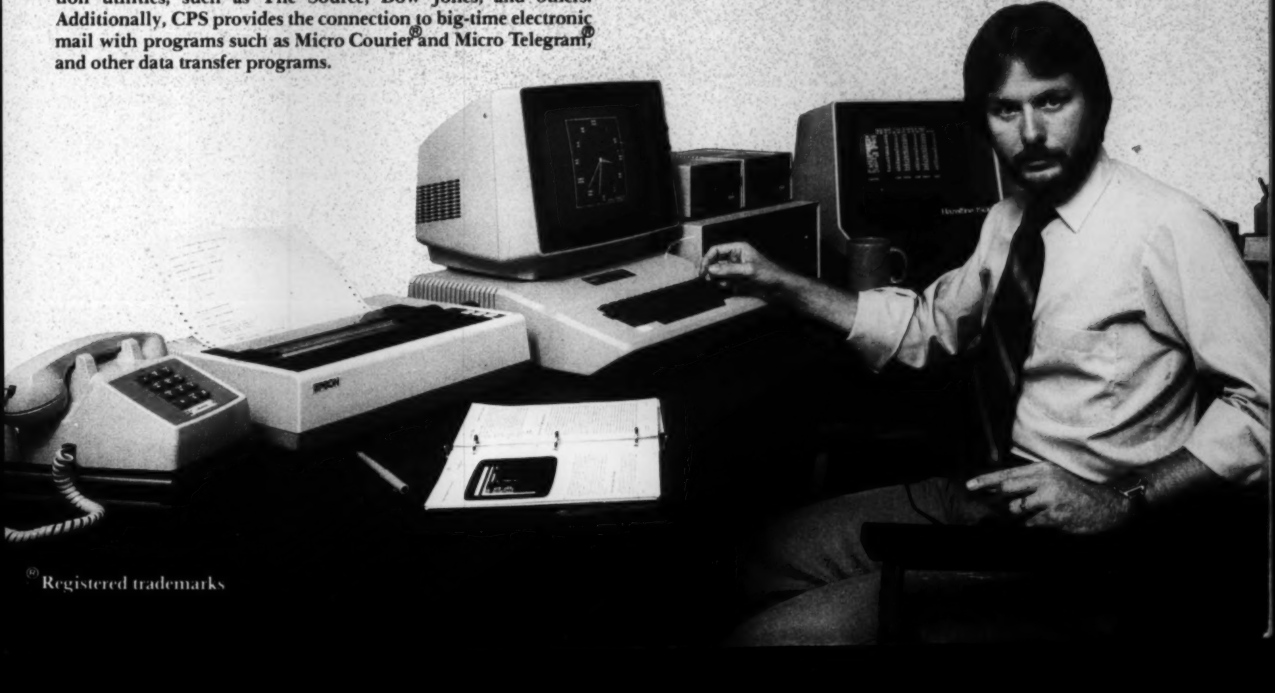

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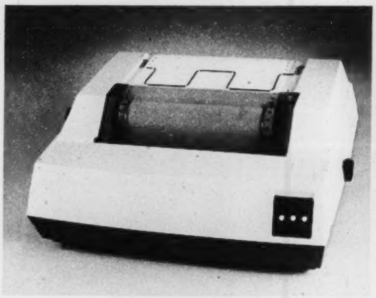

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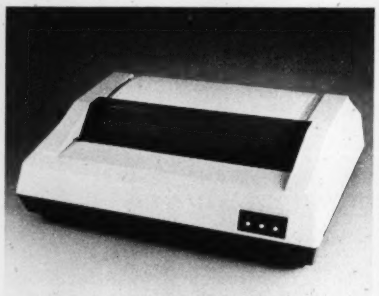

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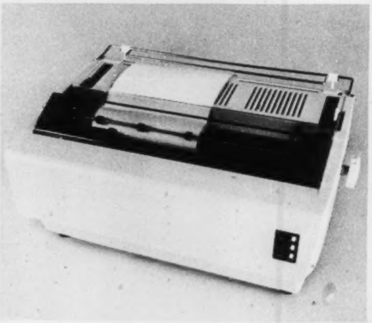

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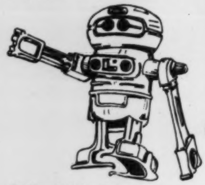

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For further information, or for help in selecting your seminars, call (212) 598 7771.

Contest Winner

In conjunction with our exhibits at the National Computer Conference and the summer Consumer Electronics Show in May and June, *Creative Computing*, *Microsystems* and *SYNC* held a drawing for a free Sinclair ZX80 computer.

About 400 people participated in the contest, of which Jeffrey M. Eby was the winner. Mr. Eby is a remote terminal specialist for United Airlines in Comstock Park, Montana.

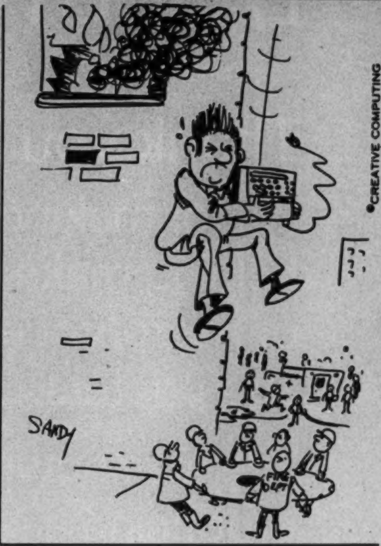
We can't guarantee that you will win a computer, but we do encourage readers to look us up at one of the many computer shows we attend. We exhibit at about 200 shows each year, from the giant trade shows such as NCC to small one-day educational conferences, from Cedar Falls, Iowa to Birmingham, England.

We enjoy meeting our readers, and are eager to learn how our magazines can serve you better.

Fortran Anecdotes Wanted

Pioneer Day at the 1982 National Computer Conference will honor the 25th anniversary of Fortran. A special commemorative publication will be a collection of anecdotes about early uses of Fortran (before 1965). If readers can supply any such anecdotes or other humorous, interesting or horrifying incidents, please send them to J.A.N. Lee, IBM Corp., M43/D27, 555 Bailey Ave., San Jose, CA 95150.

And then there was the one about the Mariner probe to Venus going astray and an undeclared variable type.



Corrections

We made a goof in the July, 1981, "dateline: tomorrow" (page 6). Just over 7600 school *districts*, not schools, have computers which are used for instructional purposes. Over 13,000 secondary schools and over 9500 elementary schools used computers to teach during the 1980-81 school year.

In the program for "Caesar's Watch" (June 1981, page 169), line 2370 should read: GOSUB 3000.

The following lines were omitted from Evan Heit's "Tree" program (August 1981, page 126).

```
5040 GOSUB5500
5045 NEXTJ
5050 RETURN
5250 REM VERTICAL GROWTH
5255 NEEDED=8+24*RHEIGHT(J)
5260 RHEIGHT(J)=RHEIGHT(J)+TURN(J,4)/NEEDED
5263 IFRHEIGHT(J)<1THENRETURN
5265 IFRHEIGHT(J)>8THENRHEIGHT(J)=8
5270 FORK=1TORHEIGHT(J)
5275 BELOW$(K)=LEFT$(BELOW$(K),1+6*J)+CHR$(48+J)+MID$(BELOW$(K),3+6*J)
5280 NEXTK
5285 RETURN
5500 REM HORIZONTAL GROWTH
5505 IFRHEIGHT(J)<1THENRETURN
5510 RH=RHEIGHT(J):NEEDED=6+2*RH
5515 WIDTH=TURN(J,5)/NEEDED+.5:IFWIDTH>5THENWIDTH=5
5518 IFWIDTH<1THENRETURN
5520 FORK=(2.5+6*J)-WIDTHTO(3+6*J)+WIDTH
5525 IFMID$(BELOW$(RH),K,1)<>" "THEN5535
5529 SIZE(J,2)=SIZE(J,2)+2
5530 BELOW$(RH)=LEFT$(BELOW$(RH),K-1)+CHR$(48+J)+MID$(BELOW$(RH),K+1)
5535 NEXT
```

Two lines from "Stoneville Manor" (August 1981, page 163) were not printed properly. They should read:

```
8120 DATA "AT THE EDGE OF A
     GORGE", "ON MAIN STREET",
     "INSIDE THE GENERAL STORE",
     "INSIDE THE HOSPITAL", "IN
     THE FOYER", "IN THE PARLOR"

8140 DATA "AT THE TOP OF A STAIR
     WAY", "AT AN OUTLET IN THE
     DUCT", "AT A TURN IN THE
     DUCT", "AT A FORK IN THE
     DUCT", "AT AN OUTLET IN THE
     DUCT", "AT A TURN IN THE
     DUCT"
```

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input/output

Avid Reader

Dear Editor:

I have a complaint to register! Your magazine is threatening my job. I conned my boss into subscribing, and now I spend all my time reading and rereading *Creative Computing*. The final irony is that my main work is done on an IBM System/34 (a really nice machine) in RPGII (some nifties, but definitely hostile to structured, easy-to-read programs). We also have a Basic/4 model 610 with cash projection and games, so far.

I am also debating heavily with my wife and budget for a personal computer. I am impressed with the software available for the Apple (my tentative first choice), but are there really that many disk systems out there? I'm going to be scraping the bottom to get the computer, let alone the extra memory and disk drive. Is everyone rich but me? Oh well...

Even without a personal computer, I have avidly followed everything you have published on Adventure. I also loved the Smalltalk overview, especially in light of all the teasers you threw in. The thought also occurred to me that the various Adventures look like limited implementations of Smalltalk. Am I close?

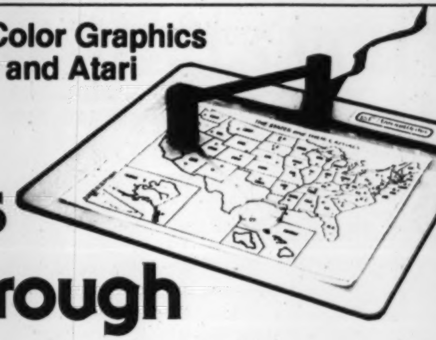
Thanks for a great magazine. You seem to have the best mix of practical theory and novice/advanced. After six years in DP, I still learn something (usually *several* somethings) from each issue.

Dana Taylor

And we thank you very much. Yes, get a disk for your Apple even if it means you have to mortage the children. Is Smalltalk like Adventure? Well, let's say that if you program in Smalltalk you create your own Adventure. And getting mixed up with the language at all tends to be an adventure in itself—ED.

High-Resolution Color Graphics for the Apple and Atari

Graphics Breakthrough



How many programs have you written that would benefit from animated high-resolution graphics? Probably several. It is this kind of dramatic graphics that distinguish outstanding programs from ordinary ones. But if you've ever agonized for hours or days just to get one image perfected, you're probably not anxious to do it again. Now there's a better way.

New Graphics Entry System

Today there is a new graphics system available that is not only amazingly user-oriented but surprisingly economical. Called VersaWriter, it starts with an ingeniously simple entry board consisting of a 14" X 12" high impact plastic bed with a tough clear plastic overlay sheet. The original drawing or diagram is fastened with masking tape to the plastic bed and then covered with the clear sheet. Instead of using a light pen or complicated electronic X-Y head, the VersaWriter uses a double jointed arm attached to the top of the entry board at one end and a magnifying lens with crosshairs at the other end. The VersaWriter resembles a draftsman's pantograph on a smaller scale.

At each joint in the arm of the VersaWriter is a potentiometer. A cable from these pontentiometers connects to the paddle input of the computer. No special interface electronics or board is needed. Since the arm of the VersaWriter bends only in one direction, each point on the plotting head corresponds to a unique set of resistances on the potentiometers. All that's needed now is software to translate these resistances into usable screen coordinates.

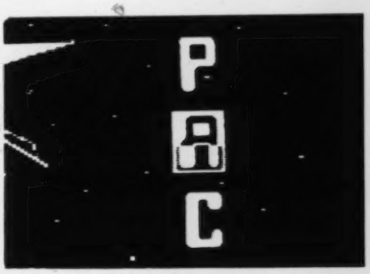
Exceptionally powerful software

It is in the software where VersaWriter really stands out. VersaWriter comes with two full disks of user-oriented software. First it has sets of "low level" commands for entering, creating and copying drawings and diagrams. Secondly, it has extensive sets of application routines for moving, enlarging, rotating, coloring or animating drawings that the user has created.

Graphics Systems

Versa Writer	**$249.00**
Kurta Graphics Tablet	**695.00**
Summagraphics Digitizer	**745.00**
Houston Instruments Hi Pad	**795.00**
Apple Graphics Tablet	**795.00**

Of course the basic commands let you enter a drawing freehand or by tracing it. Want a wider "brush stroke"? Six widths are available. Drawings can be independently scaled in both the vertical and horizontal directions. An enclosed shape may be filled in with any of 212 colors. No, that is not a misprint—by the same technique that a printing press can create hundreds of colors from three primary ones, so can VersaWriter.



Here a shape (the letter A) is being scanned. After putting it in a shape table it may be used in other programs.

```
ENTER COMMAND                X= 279
                             Y= 8
```

From the shape table, a shape (the letter A) may be enlarged, shrunk, rotated, colored or moved about the screen.

Create Animation for Other Programs

The shapes you create with VersaWriter can be used and manipulated with ease in other programs. Up to 255 shapes can be entered into a shape table. These shapes may then be placed on the screen in any position or may be overlaid on a full or partial screen image. Animation is produced easily by moving about a portion of the image created by VersaWriter. For example, by alternating between two images of an airplane propeller it will appear to be spinning.

Other VersaWriter software includes text-writer with which text can be added to graphics. Upper and lower case, choice of color, text size, direction and starting point all may be specified.

The Area/Distance program lets you calculate distances (or perimeters) by entering a scale and tracing a shape or map route with the drawing arm. Areas of figures, open and irregular, can be similarly calculated.

The software also includes sets of electronic and computer logic shapes. In addition, an entire disk of dramatic demonstration graphics is included. These twelve full-screen graphics run the gamut from a fully labeled cross section of a human skull to colored maps to animated cartoons to an electronics schematic.

Free Software Updates

You may have read a review of VersaWriter that indicated that the color fill routine was slow. It was. But not anymore. Several new routines and improvements were added to the VersaWriter software since its introduction. All customers of Peripherals Plus received these changes free.

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VersaWriter requires an Apple II with Applesoft in ROM (or an Apple II Plus), disk, and 48K of memory. The Atari version requires an Atari 800, disk and at least 32K. It is priced at $300.

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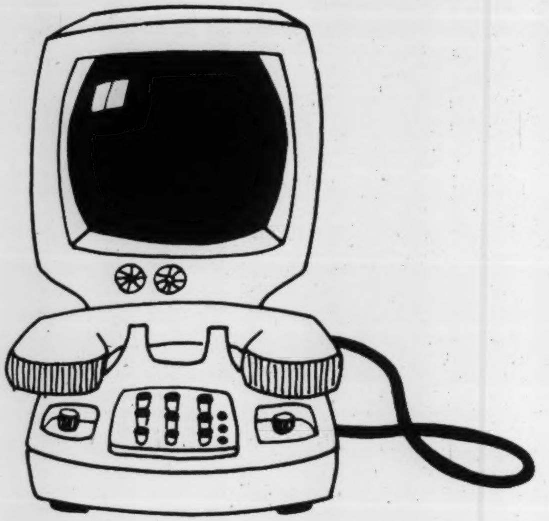

Apple Accolade

Dear Editor:

I just received the June *Creative Computing* and am delighted with the Apple coverage. Bob Sander-Cederlof's one liners are a challenge to analyze and a joy to behold. Paul Raymer's "Caesar's Watch" is a lot of fun. (Might I suggest the following watch cleaning:

```
Add     635  START=1:M=M-1:GOSUB2260:
             M=M+1:START=0
Add    2305  IF START THEN RETURN
Change 2310  R=37
Change 3040  FOR X=17 TO 37
```

The flow is a bit better with these changes.)

The highlight of the issue is David Lubar's "Picture Packer." I am now busily packing pictures and am most pleased with the speed on the routines. Loading and displaying a packed picture is, on the average, much faster than using the original. *And* with no noticeable loss of quality!

Stephen M. Lawson
The G.R.A.P.E
P.O. Box 283
Port Orchard, WA 98366

Surface Mail

Dear Editor:

I have recently started my second subscription with *Creative Computing*. One of the main reasons for this renewal was an article by Rod Hallen in the December, 1979, issue titled "Battle of the Assemblers." Not everyone out here is a "Basic only" user. I really appreciated the article and found it most informative.

Larry W. Smith
E-Systems
PSC-1 Box 27347
APO San Francisco, CA 96230

Your Numbers Are Dazed

Dear Editor:

Perhaps others have written regarding this bug in Apple Renumber on the System Master Disk, but I haven't seen it as yet in *Creative Computing* or any other computing magazine.

If this line is used in the program to be renumbered:

```
100 A=INT(A*100+.5)/100
```

frequently, but not always, and with no apparent pattern, the line will be changed to read:

```
100 A=INT(A*136+.5)/100
```

The "136" within the parentheses seems to be random but sometimes will be the line number.

When the program (Renumber) decides to perform this little bug-a-boo, elsewhere in the renumbered program, arithmetic lines may be changed from:

```
130 A=B-(C*125) to: 130 A=B-(C*136)
```

The "136"being the same number that was substituted in line 100 above.

I have never seen a number outside parentheses suffer this change—only those inside.

E.B. Buchanan
c/o E G & G
P.O. Box 5 Pasir Panjang P O
Singapore 0911

The problem seems to occur after an asterisk. There might be a fix, but I haven't been able to track it down. The best bet is to use variables for multiplication. Perhaps a reader knows the fix.—DL

Lefthanded Compliment

Dear Editor:

I greatly enjoyed the listing of Leo Christopherson's "Android Nim" in the June 1981 issue of *Creative Computing*. However, I found one bug in the program. When one of the three androids on the left of the screen raised his arm to "zap" the other androids, his arm didn't go back down. Instead, one of the 15 regular androids lowered his arm. To correct this, I changed line 8405 from:

```
8405 GOSUB 8040: GOSUB 8005: X3=X: GOSUB 8070:
     X=X3: GOSUB 8045: GOSUB 8450: GOSUB 8500:
     GOSUB 8050: GOSUB 8010: GOTO 8325
```

to:

```
8405 GOSUB 8040: GOSUB 8005: X3=X: GOSUB 8070:
     X=X3: GOSUB 8045: GOSUB 8450: GOSUB 8500:
     X=X3: GOSUB 8050: GOSUB 8010: GOTO 8325
```

Another thing I noticed was that line 8400 was listed as:

```
8400 GOTO 8405: GOSUB 8040: X3=X: GOSUB 8070:
     X=X3: GOSUB 8005: X3=X: GOSUB 8070: GOSUB
     8070: X=X3: GOSUB 8045: GOSUB 8450: NEXT N:
     GOSUB 8500: GOSUB 8050: GOSUB 8010: GOTO
     8325
```

Since the first statement of this multi-statement line is a GOTO, control will never go beyond the first statement in this line. I therefore replaced this line with:

```
8400 GOTO 8405
```

with no apparent changes in program execution.

With these two changes, "Android Nim" is a very enjoyable program for my TRS-80. I hope to see more such programs in future issues. Thank you.

Jerry Schremp
312 Mary St.
Antigo, WI 54409

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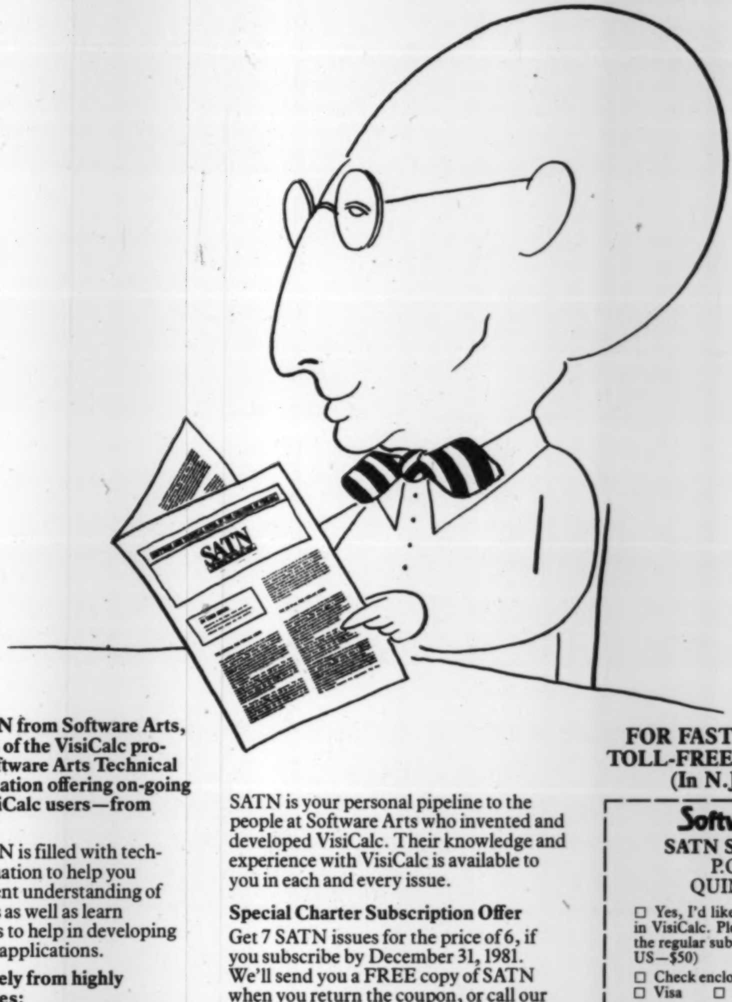

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Standing Ovation

Dear Editor:

I'd like to compliment Laurie Spiegel for an interesting article on electronic music ("Macromusic from Micros." May 1981 *Creative Computing*). Her opinions on the facts and foibles of computer music are sensible and pertinent, and she explains them quite clearly.

There are many hobby-horse riders in electronic music who will take offense at some of Miss Spiegel's statements. They must follow their own ideas, of course, but Miss Spiegel's article expresses what I, as a serious electronic-music composer, have long thought.

Allen Watson III
1261 Robbia Court
Sunnyvale, CA 94087

Smooth Estimate

Dear Editor:

I enjoyed the program by John W. Essig entitled "Home Construction Cost Estimate" which was published in the August edition of *Creative Computing.*

A deficiency of the original program is lack of a provision for quick revision of specifications, location and/or grade of construction without rerunning the entire program.

I would be happy to send the Atari Basic program to any of your readers who would be interested in having it.

Robert Gordon, M.D.
6191 South Forest Rd.
Littleton, CO 80121

Big Trouble

Dear Editor:

I am having a problem, and maybe some of your readers can help.

As the owner of an Apple II, I have compiled some of my very favorite programs and used good parts of each.

For example, I've taken Roger Wagner's Apple DOC and used the feature of locating and changing names of variables. I've used Sensible Software's Super Disk III to alphabetize my catalog, after using the Beagle Bros' DOS BOSS to customize my catalog by putting their name on it, as indicated in their instruction book.

Then using Apple's Tool Kit I have been able to shorten the programs to load faster and with Synergistic Software's Higher Graphics by Robert Clardy, I've done some beautiful things.

All of this I have now combined onto one disk—all of these remarkable programs—and now my problem:

This disk is 18" wide, because of the stuff on it. How can I get it into my disk drive?

Can any of your readers help?

Paul Raymer
Paul's Electric Computer
P.O. Box 42831
Las Vegas, NV 89104

We checked with our hardware pro, Will Rubic, who provided the following insight for a mere $200. "I had a similar problem a few years back. The first thing I did was take a hacksaw (Stanley #307 with a 37cc905-602 blade works best here) and expand the front slot of the disk drive along both sides. Be careful not to damage the write-protect sensor. Next, the spindle and read head have to be extended. Read-head conversion is fairly simple, using Erector brand multi-holed building shafts. The spindle is another matter. After several weeks of experimentation, I discovered that the transmission from a '73 Mustang is ideal. An external power supply completed the fix. When it didn't work, I bought a Corvus."

We Have Ways to Make Things Tock

Dear Editor:

Referring to the "Caesar's Watch" program on page 166 of the June 1981 issue of *Creative Computing*: I noticed this program lurking in the back somewhere and thought it looked pretty good, so I plugged it in to my school's 48K Apple II+.

Thirty mintues and two sore hands later it was ready to go. I tried it and found that it was great, unfortunately it seems that the author forgot one minor detail, sound. I mean what is a clock without the tick-tock, or should I say "drip-drop."

So I figured, why not add the sound for him, and here it is:

```
275   C+= - 16336
1045  Z = PEEK (C) + PEEK(C) + PEEK(C) - PEEK (C)
2085  Z = PEEK(C) + PEEK(C) + PEEK(C) - PEEK(C) +
      PEEK(C) +PEEK(C)
3255  Z = PEEK(C) + PEEK(C) - PEEK(C) + PEEK(C)
```

Aaron Spilling
The Computer Room
Gwinn High School
Box 402
Gwinn, MI 49841

Mutual Admiration

Dear Editor:

I was very surprised at the number of inquiries we received in response to our article "Investing in Mutual Funds," (*Creative Computing*, May 1981). The listings we provided did not copy, so they were manually retyped and several errors crept in. We will be happy to provide copies of the original listings to readers who send an SASE.

The data we used when we wrote the article is now about two years old and is not of much use. But there is an alternative to going to the library and digging through 39 weeks of newspapers. A small computer firm in Albuquerque publishes an inexpensive booklet, updated weekly, containing one year's worth of market index values and net asset values of selected mutual fund groups. This booklet can save a lot of time. The address is:

Meta Software Engineering
P.O. Box 18056
Albuquerque, NM 87115

One aspect of the system which we should have stressed in the article is that one must not ask the fund group managing the investment to switch too often. They may restrict the investor's privileges. I have called my fund group only eight times since January 1, 1979. If the system is used correctly, switching shouldn't be too frequent to upset any reasonable management.

John S. Browning
2071 B. Mercury Dr. SE
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An Alternate Approach to Input in the Classroom

Keith Schlarb

> *We just received notice that, based on feedback from field use of prototypes such as the one described below, Mountain will be releasing an improved card reader in early 1982. This comparably priced unit will feature automatic load and an improved read head. It will be able to read both mark-sense and punch cards.*

Cardreaders can be the answer to data entry from remote locations. They have been used successfully in such applications as inventory control and employee time records. For the educator the cardreader can solve the problem of providing computer experience without the high cost of purchasing several computers.

Two cardreaders are currently on the market—the Mountain Computer cardreader and the Chatsworth Data cardreader. I use both in my classroom.

A previous equipment review concerning the Chatsworth Data reader appeared in the April 1980 *Creative Computing*, and I will refer to it occasionally.

Equipment Description

The Chatsworth reader is a compact 4.6" x 4.3" x 4.5" and is composed of the main reader housing with the drive monitor, and AC/DC converter, and interface card. All are included in the purchase of the reader. The reader uses a standard electrical outlet.

The Mountain Computer reader is larger at 7.75" x 5.25" x 14.5" with the main housing containing the drive motor, sensors, and a rack to catch the programming cards. A high speed serial interface set to 2400 baud is required, but is not part of the package. The power supply uses a standard grounded outlet.

Hook-up and Sensing

Both cardreaders are very simple to connect to the Apple computer. Simply connect the interface to one of the slots of the Apple. Both companies suggest slot 4, but the readers do work in other slots. Connect the power cord, type IN#s, with s representing the slot of the interface, and the readers are ready for use.

	Chatsworth Data	**Mountain Computer**
Price	$750	$1195
Card Price	$25/1000	$16/1000
Interface	Included	Extra
Cols.	40	20
Reads	Characters	Characters, statements
Read Method	Needle contact	Optical

Table 1.

The Chatsworth reader automatically turns on the drive motor when a card is entered. As the card passes through the reader, the marks on the programming card are sensed by three electronic needle sensors in each row. A small amount of current must travel between the needles for accurate sensing of the marks. The cards drop on the table surface after passing through the reader. The Chatsworth Data reader requires the use of a soft #2 pencil, but more accurate readings can be obtained with an electronic lead pencil.

The Mountain Computer reader drive motor is turned on from the rear panel. Cards are drawn through by the drive motor and scanned by optical infrared sensors. After sensing, the cards are stacked in the order in which they were entered at the rear of the reader in the card rack. The rack has a maximum capacity of 50 cards, and is quite a time saver. Since light sensors are used, marks may be made

---

Keith Schlarb, 5617 Indianola Ave., Worthington, OH 43085.

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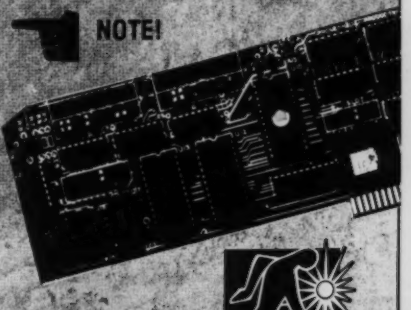
Parallel, Serial and Realtime Clock Interfaces?	YES	YES
BSR Control Interface?	YES	NO
Compatible w/ Apple Pascal?	YES	NO. Special Pascal disk required.
Compatible with CP/M?	YES	NO. Special CP/M disk required.
Cable Included?	YES. One cable of choice free with each order – through 1981.	NO. Must be purchased separately.
Apple Modification?	NO	YES

NOTE!



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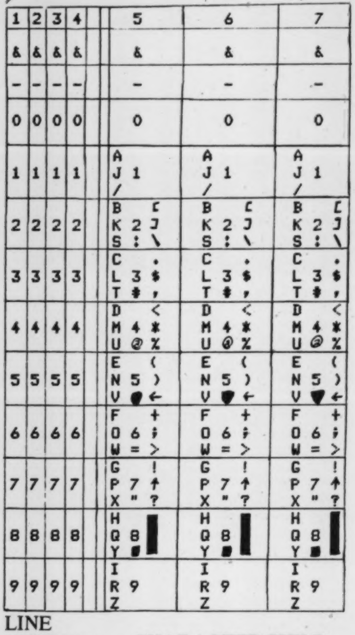
CIRCLE 282 ON READER SERVICE CARD

Cardreaders, continued...

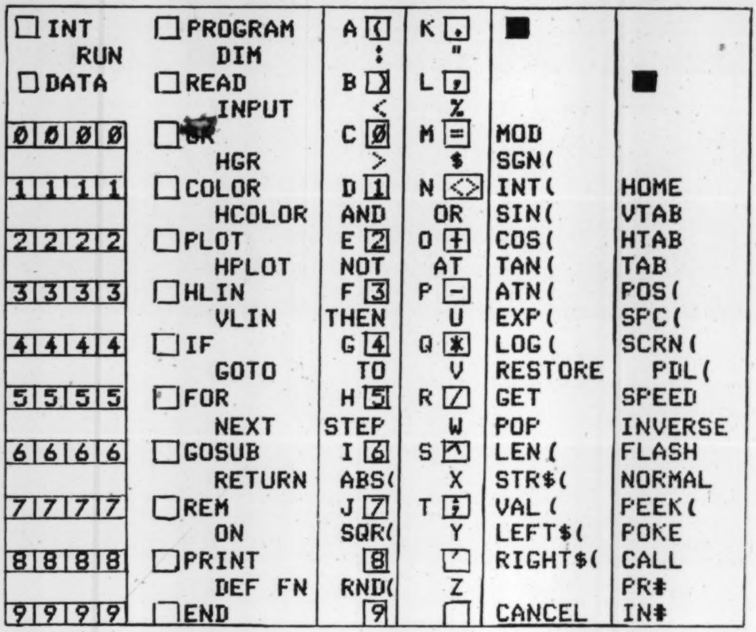


1	2	3	4			5	6	7
&	&	&	&			&	&	&
-	-	-	-			-	-	-
0	0	0	0			0	0	0
1	1	1	1			A J 1 /	A J 1 /	A J 1 /
2	2	2	2			B [K 2] S : \	B [K 2] S : \	B [K 2] S : \
3	3	3	3			C . L 3 $ T # ,	C . L 3 $ T # ,	C . L 3 $ T # ,
4	4	4	4			D < M 4 * U @ %	D < M 4 * U @ %	D < M 4 * U @ %
5	5	5	5			E (N 5) V ♥ ←	E (N 5) V ♥ ←	E (N 5) V ♥ ←
6	6	6	6			F + O 6 ; W = >	F + O 6 ; W = >	F + O 6 ; W = >
7	7	7	7			G ! P 7 ↑ X " ?	G ! P 7 ↑ X " ?	G ! P 7 ↑ X " ?
8	8	8	8			H █ Q 8 █ Y ■ █	H █ Q 8 █ Y ■ █	H █ Q 8 █ Y ■ █
9	9	9	9			I R 9 Z	I R 9 Z	I R 9 Z

LINE NUMBER FIELD

CHARACTER FIELD

Figure 1. Sample of first 7 columns of a Chatsworth Data Programming card. The cards have a total of 40 columns.



☐ INT	☐ PROGRAM	A (	K .	■	
RUN	DIM	:	"		
☐ DATA	☐ READ	B)	L ,		■
	INPUT	<	%		
0 0 0 0	☐ GR	C 0	M =	MOD	
	HGR	>	$	SGN(	
1 1 1 1	☐ COLOR	D 1	N <>	INT(	HOME
	HCOLOR	AND	OR	SIN(	VTAB
2 2 2 2	☐ PLOT	E 2	O +	COS(	HTAB
	HPLOT	NOT	AT	TAN(	TAB
3 3 3 3	☐ HLIN	F 3	P -	ATN(	POS(
	VLIN	THEN	U	EXP(	SPC(
4 4 4 4	☐ IF	G 4	Q *	LOG(	SCRN(
	GOTO	TO	V	RESTORE	PDL(
5 5 5 5	☐ FOR	H 5	R /	GET	SPEED
	NEXT	STEP	W	POP	INVERSE
6 6 6 6	☐ GOSUB	I 6	S ^	LEN(	FLASH
	RETURN	ABS(	X	STR$(	NORMAL
7 7 7 7	☐ REM	J 7	T ;	VAL(	PEEK(
	ON	SQR(	Y	LEFT$(	POKE
8 8 8 8	☐ PRINT	8	'	RIGHT$(	CALL
	DEF FN	RND(	Z		PR#
9 9 9 9	☐ END	9	☐	CANCEL	IN#

LINE NUMBER FIELD

COMMAND FIELD

CHARACTER FIELD

LIBRARY FIELD

Figure 2. Mountain Computer programming card. There are 15 character fields on the cards.

with any making medium that is visible to infrared light. Accurate results are obtained with soft #2 pencils and certain black magic markers.

Program Card Marking

Figure 1 shows an enlarged portion of a Chatsworth card. When marking a program on Chatsworth cards, columns 1-4 are reserved for line numbers. Columns 5-40 are marked for the Basic statement using the standard Hollerith Code. Figure 3, shows the symbol locations, symbols, and the appropriate marking of the cards. For further examples of marking the Chatsworth cards, refer to the April 1980 article. The Chatsworth reader may also be used for entering binary information by card image.

An enlarged view of a Mountain Computer card may be seen in Figure 2. Again the first four columns are used for line numbers. Above these columns three commands appear; INT, RUN, DATA. The correct marking of the three commands is: INT-correct box, DATA-correct box, RUN-both boxes. Next is the command field. The commands in this field are marked the same as those just mentioned, either the correct box is used or both boxes are used if the command appears between them. For example, the VLIN command is marked by filling both the HLIN and IF boxes, see Figure 4. Note the area between the boxes may also be filled, but it is not necessary to do so.

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CIRCLE 264 ON READER SERVICE CARD

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CIRCLE 245 ON READER SERVICE CARD

Cardreaders, continued...

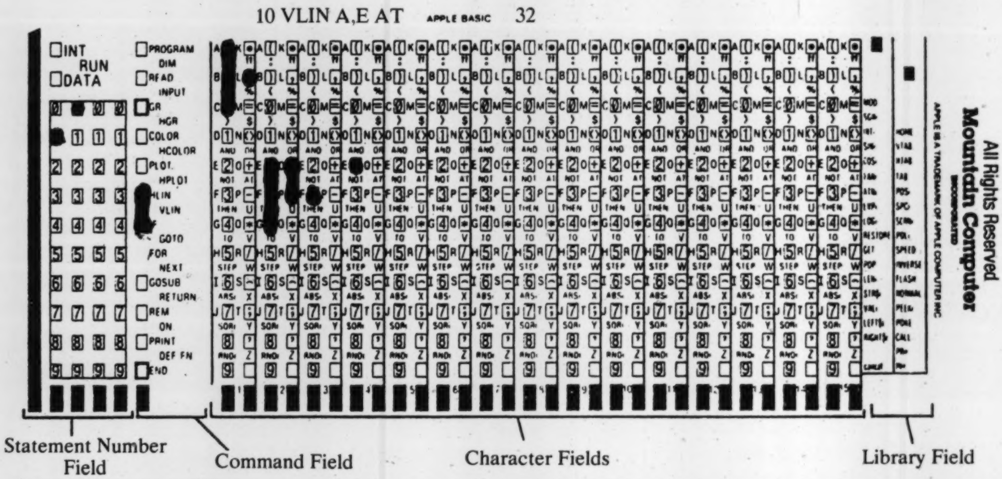
```
SYMBOL LOCATION          SYMBOLS                  MARKING

Center of box            1 2 3 4 5 6 7 8 9 0      appropriate box
top left of box          A B C D E F G H I        appropriate box plus &
center left of box       J K L M N O P Q R        appropriate box plus -
bottom left of box       / S T U V W X Y Z        appropriate box plus 0
bottom center of box     : # @ ' =  "             appropriate box plus 8
top right of box         [ . < ( + !              appropriate box plus & plus 8
center right of box      ] $  *  ) ; ↑            appropriate box plus - plus 8
bottom right of box      \ ,  % ← >  ?            appropriate box plus 0 plus 8
carriage return &589  or automatic at end of card
line feed  059
```

Figure 3. Outline of marking sequence used for Chatsworth Data cards.

The next area is the character field which is composed of 15 columns. The marking in this field is as follows: 1) If the symbol is within the box then mark that box. 2) If the symbol is between two boxes then mark the box above and below the symbol. 3) For a symbol to the left of a box, mark the box on the right plus the next two boxes below. See Figure 4, for an example of VLIN A,E AT 32.

The final field is called the library field. Marking for the items of the left column in the library field is completed by marking either top boxes in the character field, [(] or ⊡, plus the box which lines up with the desired item. For example, marking the [(] and [6] in any character field column would generate the LEN(statement, while


10 VLIN A,E AT
APPLE BASIC
32
INT
RUN
DATA
PROGRAM
DIM
READ
INPUT
GR
HGR
COLOR
HCOLOR
PLOT
HPLOT
HLIN
VLIN
GOTO
FOR
NEXT
GOSUB
RETURN
REM
ON
PRINT
DEF FN
END
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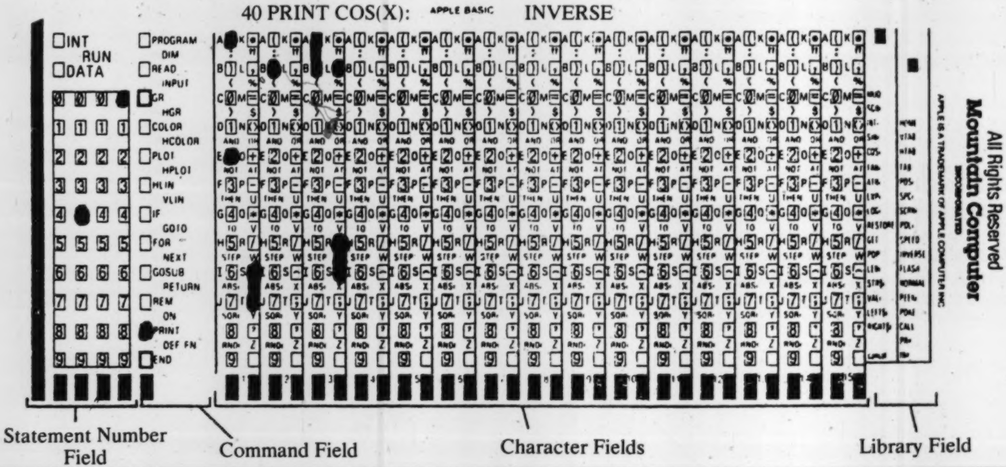
APPLE IS A TRADEMARK OF APPLE COMPUTER INC.
Statement Number Field
Command Field
Character Fields
Library Field

Figure 4.


40 PRINT COS(X):
APPLE BASIC
INVERSE
INT
RUN
DATA
PROGRAM
DIM
READ
INPUT
GR
HGR
COLOR
HCOLOR
PLOT
HPLOT
HLIN
VLIN
IF
GOTO
FOR
NEXT
GOSUB
RETURN
REM
ON
PRINT
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END
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Statement Number Field
Command Field
Character Fields
Library Field

Figure 5.

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CIRCLE 150 ON READER SERVICE CARD

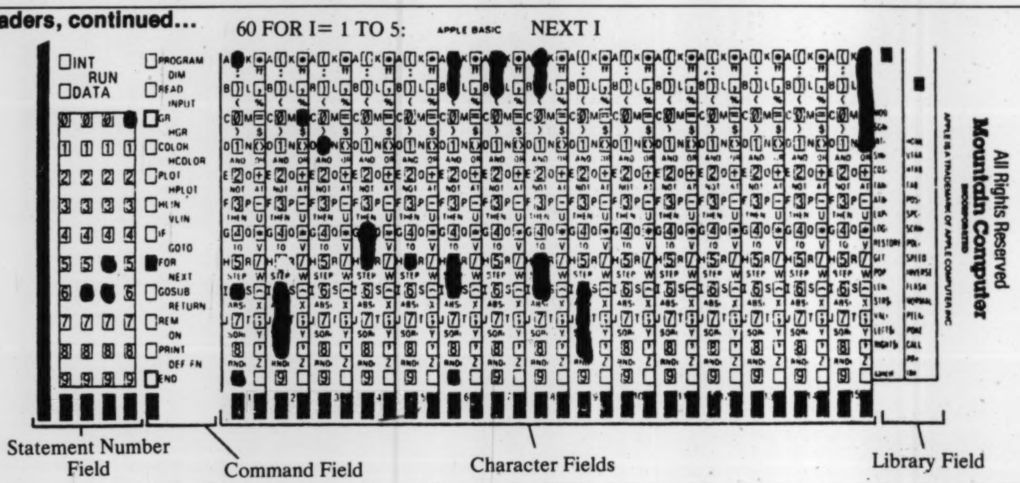

Figure 6.

a $\boxed{(}$ $\boxed{6}$ and $\boxed{7}$ marking would generate the STR$(statement. See Figure 5 for an example of marking library field items. From the example, it is seen that the $\boxed{(}$ plus two boxes are used if the statement of the library field occurs between the boxes. The items in the right column of the library field are marked in a similar way, except the $\boxed{)}$ or $\boxed{,}$ are used to indicate the right column of the library field, see Figure 5. Notice that all statements requiring parentheses have the open parenthesis included. For example, marking for COS results in COS(. The library field items which include the open parenthesis are: SGN(, INT(, SIN(, COS(, TAN(, ATN(, EXP(, LOG(, LEN(, STR$(, VAL(, LEFT$(, RIGHT$(, POS(, SPC(, PEEK(, SCRN(, PDL(. This is an indication of the thought involved in the card design.

Other possible uses of this well-designed system follow. First, commands from the command field may be used elsewhere in the character field by marking the top first and second boxes of the character field, $\boxed{(}$ and $\boxed{)}$ or $\boxed{,}$ and $\boxed{.}$, and the appropriate box lining up with the desired command. The following commands DIM, READ, PROGRAM, GR, and END may not be used in this way. Figure 6, column 6 shows this method used to mark the NEXT statement.

Yet, another handy tool can be used for correcting mistakes. A line number column will be ignored by the reader if two marks appear in the same column. The reader will also ignore character field columns if the top and bottom boxes in one column are marked. Figure 6, line number column 3, and character field columns 1 and 6, show the method used to eliminate columns with marking errors.

Another handy feature is the ability to mark the cards for multiple statement lines. Marking the top four boxes of the very last column allows any line number statement to continue on the next card

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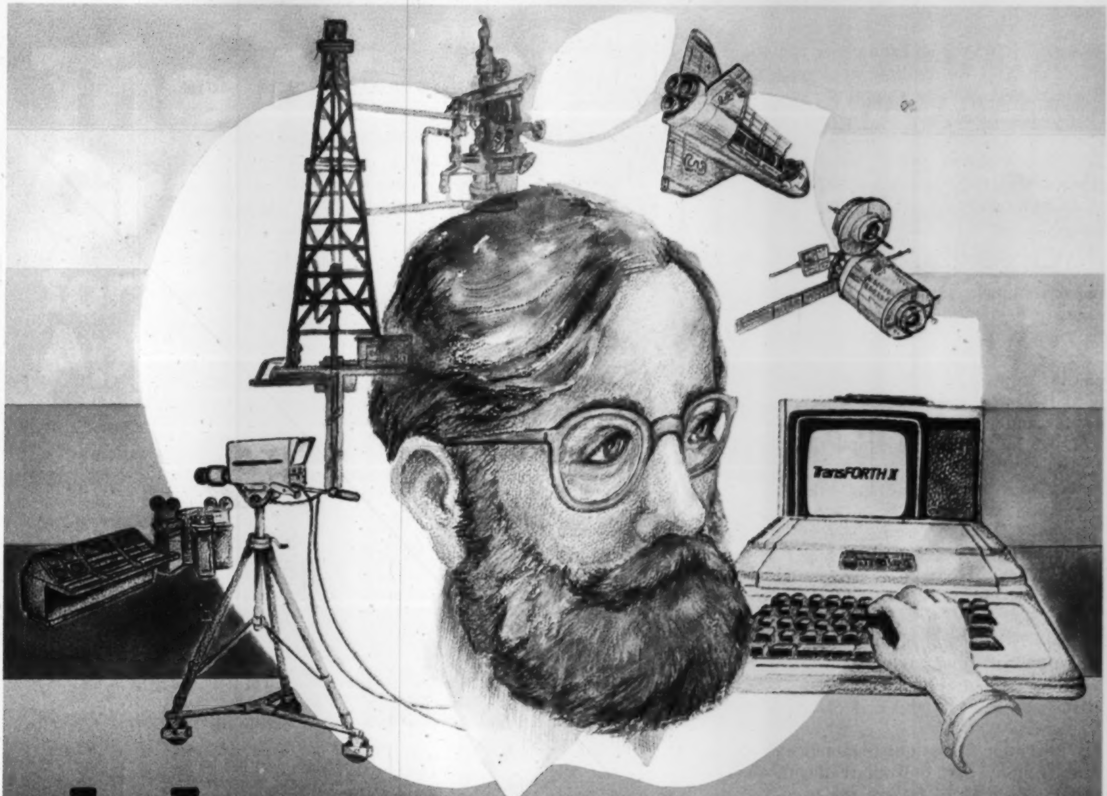
CIRCLE 204 ON READER SERVICE CARD



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CIRCLE 152 ON READER SERVICE CARD

read. See Figure 6 for an example of the indicator marking for multiple statement lines which cancels the automatic return and allows the use of another card for the line number. This process may continue up to 255 characters. See Figure 7, for symbol location, symbols, and appropriate marking method for Mountain Computer cards.

The cards may also be used to input hexadecimal data. The hex data is converted to its binary equivalent, and then the ones are marked on the card with zeros remaining empty. Each column represents 12 bit locations. Mountain Computer states in the manual that this form of data input may be used with any computer and most any purpose when interpreted by a program prepared by you. I suggest if you are interested in this use you check a manual at the nearest dealer or contact Mountain Computer.

Data Entry

Entry of Basic programs is completed in a similar manner with both readers. The cards marked with Basic statements are entered, and the statements are printed on the monitor screen and entered into RAM as the cards are read. An automatic return is generated at the end of each card.

The Mountain Computer reader does require the initial card to be marked with either PROGRAM to inform the cardreader the program is in Applesoft, or INT PROGRAM for integer. The PROGRAM also generates an automatic NEW and TEXT, and creates line 0 REM PROGRAM: to start your program.

Several methods are available for entering data into existing programs, all of which are similar to those used from the keyboard. One method is the use of a FOR-NEXT loop. Depending on how the loop is arranged, one data item or several per card can be entered through the reader. The number of cards used can be large if only one data item per card is used. See Figure 8 for sample FOR-NEXT loops for data input.

One advantage of the Mountain Computer cardreader for data entry is the ability to use the keyboard and reader at the same time. No IN#0 instruction is required to disconnect the reader before use of the keyboard is permitted. This permits the use of the keyboard to RUN, LIST and SAVE, programs. These commands could be done through the reader, but this feature does provide additional flexibility to the overall system, and in the classroom allows students to use the keyboard for minor error correction. These uses require little time and give the students a chance for keyboard interaction.

The Chatsworth Data reader does not allow the keyboard use until an IN#0 instruction is placed through the reader.

SYMBOL LOCATION	SYMBOLS	MARKING
command field	PROGRAM,READ,GR,COLOR PLOT,HLIN,IF,FOR GOSUB,REM,PRINT,END	box on left
	DIM,INPUT,HGR,HCOLOR HPLOT,VLIN,GOTO,NEXT RETURN,ON,DEF FN	box above and below on left
LINE NUMBER field	INT,DATA	box on left
	RUN	boxes above and below on left
character field	( ) 0 1 2 3 4 5 6 7 8 9 . , = <> + - * / ; , space	correct box
	A B C D E F G H I J K L M N O P Q R S T	box on right plus next two boxes below
	: < > AND NOT THEN TO STEP ABS SQR RND " % $ OR AT U V W X Y Z	boxes above and below
library field left column	MOD,INT(,COS(, ATN(,LOG(,GET, LEN(,VAL(,RIGHT$(CANCEL	either top box of character field $\boxed{(}$ or $\boxed{.}$ plus the box in line with the item
	SGN(,SIN(,TAN(EXP(,RESTORE,POP STR$(,LEFT$(	either top box of character field $\boxed{(}$ or $\boxed{.}$ plus boxes above and below the item
right column	HOME,HTAB,POS SCRN(,SPEED FLASH PEEK(,CALL,IN#	either of the second boxes from top $\boxed{)}$ or $\boxed{,}$ plus boxes in line with the item
	VTAB,TAB,SPC(PDL(,INVERSE, NORMAL,POKE, PR#	either of the second boxes from the top $\boxed{)}$ or $\boxed{,}$ plus boxes above and below the item

Figure 7. Outline of marking sequence for the Mountain Computer cards.

```
200 FOR I=1 TO 10

210 INPUT A(I)

220 NEXT I
```

Input of one data variable per card using a FOR-NEXT loop.

```
200 FOR I=1 TO 27 STEP 3

210 INPUT A(I),A(I+1),A(I+2)

220 NEXT I
```

Figure 8.

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The **A2-GE1 Graphics Editor** requires the A2-3D1 or 3D2 and includes **Object Editor**, **Motion Programmer**, **Motion Playback**, and **Slide Show Playback**. It also includes a special A2-3D2 interface for BASIC programmers.

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CIRCLE 187 ON READER SERVICE CARD

```
           CORRECT ANSWERS
           ------- -------


1.  A           24. B
2.  B           25. A
3.  C           26. C

STUD. ANSW.       RIGHT
----- -----       -----
0001  ABCAABCCCC  29
0002  CBCCCBBCCA  29

  NUMBER OF PUPILS:19

         TOP SCORE:39
    UPPER QUARTILE:33
            MEDIAN:29
    LOWER QUARTILE:26
      BOTTOM SCORE:18



             MEAN:29.37
STANDARD DEVIATION:5.1

           ITEM  ANALYSIS
           ----  --------



QUESTION      DIFFICULTY  DISCRIMINATION
--------      ----------  --------------
   1              72            33
   2             100             0
   3              72            33
```

```
STUDENT &                          ITEMS
# CORRECT    # WRONG   AVG.        MISSED

----3
  10           35      22%      1  4  7  10
                                11 12 13 15

ITEM ANALYSIS

ITEM #    # CORRECT   # WRONG    % CORRECT

  1          2           2            50 %
  2          2           2            50 %
  3          2           2            50 %

SUMMARY OF TEST SCORES

TEST SCORE        # OF TESTS

     19               1
     10               1
     9                1
     7                1
THE MEAN TEST SCORE IS 11.25
THE STANDARD DEVIATION IS 4.60298816
```

Figure 9. Sample output from test scoring programs. Mountain Computer left. Chatsworth Data above.

Test Scoring

Both companies supply a test scoring program which is very helpful to the educator. Special test cards allow for a multiple choice test with five possible choices (A-E) for each question. Both packages have similar statistics to summarize results. See Figure 9, for a sample of the test scoring results.

The Mountain Computer scoring program will sort the student identification numbers before printing them, thus providing a list to follow the grade book. This program, as written provides only hardcopy from a printer.

The Chatsworth program gives a listing of scores by student identification number in the order of entry. This program provides only for CRT display, but has the added feature of allowing a teacher-generated response for each missed question. This option would be very useful for a computer managed instruction unit, if hardcopy were possible. The differences are minor and the programs can be changed to suit your needs if you have a little Applesoft programming experience.

Compatibility

The Mountain Computer reader is designed to operate with an Apple Computer and the Apple version of Basic, however, it should be remembered that the use of the hex data entry mode allows for use with other computers. The Chatsworth reader is available with interfaces for Apple, PET, and TRS-80.

Overall Performance

I have used the Chatsworth reader for two years in my classroom to teach a unit on computer programming. The instrument has been reliable, but has presented problems. One is the consistency of reading marks, which I believe to be directly involved with the method of sensing. The small needles actually rub across the card and thus remove some of the graphite. This results in the card being correct on one reading and possibly wrong on the next. The second drawback is the marking of cards of the Chatsworth. For example, the statement PRINT"HI" requires the student to make appropriate marks for each letter and symbol of the statement. This can result in the student concentrating more on the marking of cards than on programming.

Mountain Computer has solved both of these problems. The optical sensing method seems to be better since it allows the use of marking media other than pencils, and eliminates problems arising from rubbing off the mark, especially if markers are used. As a test, I entered a short program of three cards marked with a black magic marker. The cards were still being read correctly on the 20th trial.

The method used to mark the cards for the Mountain Computer seems to be easier for student to use. The statement of PRINT "HI" requires only one mark for the word PRINT. This greatly simplifies the card marking process for students. Also, the stacking of cards in the rack plus the ability to use the keyboard and Mountain Computer reader interchangeably without any I/O commands provides great flexibility for error correction and entry of direct commands.

Cost

Chatsworth Data is presently advertising their card reader, AC/DC converter, and interface at $750. Programming card cost on my last order was $25/1000. The Mountain Computer reader is $1195 and requires a serial interface. The Mountain Computer programming and testing cards are $16/1000.

Chatsworth Data Corporation, 20710 Lassen St., Chatsworth, CA 91311. (213) 341-9200.

Mountain Computer, Inc., 300 El Pueblo, Scotts Valley, CA 95066. (408) 438-6650. □

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CIRCLE 221 ON READER SERVICE CARD

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Word Processing Printer

The Xymec HY-Q 1000

C. A. Johnson

Some years ago, I was a full-time, professional writer. In the late 1940's and early 1950's the pulp paper magazines went the way of the dinosaurs, and just as mysteriously. Not so mysteriously, I gained a wife and recall into military service to help in the Korean police action. My career was thus interrupted, and I failed to make the transition into non-fiction. I found myself in a new career which consumed most of my creative energies, and it was over twenty years before I picked up my typewriter seriously again.

After many years away from the typewriter I found my few typing skills were lost, and a touch of arthritis was making it nearly impossible to develop any real proficiency again.

Then I heard about word processing systems and investigated them with enthusiasm. My enthusiasm dimmed quickly when I examined the price tags. It appeared that word processing was out of my reach.

Then I discovered personal computers, and soon bought my 16K Level II TRS-80 and a word processing program. Although I did not have upper and lower case, or a printer, I found it worthwhile to write my first draft and polish it on the computer. Rewriting, reorganizing, inserting, moving or deleting text was both simple and fast. I began to wonder how I had managed to get along without word processing as long as I had. It was still necessary to type the final copy from the text on the computer monitor. It was not as desirable as printing out my copy directly, but it did allow me to increase my output significantly.

Soon, I started the painful process of trying to select the proper printer for my application.

My big break came when one of my friends bought a Xymec Daisy Wheel printer (computer interfaced Olivetti ET-201 Memory Typewriter). I made the necessary arrangements with him and bought a Radio Shack upper/lower case modification and Scripsit. Our arrangement was both beneficial to me and profitable to him. I would prepare my article on my TRS-80 and take him a diskette copy for printing. My volume increased again.

Outwardly, the Xymec looks like a sophisticated business typewriter with 18 additional switches and keys. Even without a computer, the Xymec is an intelligent typewriter, and that can be a life-saver if your CPU is in the shop. With a computer, nearly all the special features are accessible using relatively simple "escape sequences." (In Basic, for example, E$=CHR$(27)+"A4":LPRINT E$ will turn on the reverse image print—white on black).

The Xymec looks like a sophisticated business typewriter with 18 additional switches and keys.

It prints at the rate of 25 characters per second, and has a switch-selectable choice of ten, twelve, or fifteen pitch, or proportional spacing. The daisy wheel is easily replaced for changing type sizes or styles.

There are several automatic functions, such as right justification, automatic carriage return, line counting to end of page, and printing in either normal, bold face, underlined, bold-underlined, or reverse image. Scripsit provides for right justification and line counting, so I found little use for those features in the printer.

I encountered no problem in hooking it up to my system. I just plugged it into the parallel port and it worked. I was pleased to find that it came with four print wheels (one for each pitch) and a carbon ribbon (nylon, correctable, and high yield carbon ribbons are readily available). It is necessary, however, to buy the Centronics 779-compatible printer cable from Radio Shack. The TRS-80 uses the parallel connection, but the Xymec can be bought with either an IEEE or RS-232 interface, as required.

There are 27 different type styles available as stand accessories. It is curious, but none of them with a standard alphabet has the symbols for "greater than" or "less than," which are required for program listings and mathematical formulae. Since they are used so frequently in computer applications, those symbols should be provided as standard on a printer designed for computer use. I called this to the attention of the Xymec representative, but was told that Olivetti had no plans to market a daisy wheel with those symbols. A print wheel with those characters can be custom ordered at a premium of $50 over the regular print wheel price (total $82).

The Xymec has given us good, reliable service. My friend's part-time word processing business keeps it running the better part of 20 hours each week, and it has been in use at that rate for over ten months without trouble of any kind.

Using the printer in conjunction with CompuServe, I have had occasional loss of characters which showed on the screen, but did not get printed out. I am not sure whether that is actually a fault of the printer, since in the many months of using the printer with Scripsit, there have been only two instances in which a character failed to print.

Overall, I have been pleased with its performance. I recommend it highly for conventional word processing applications, and consider it well worth the $2650 price tag.

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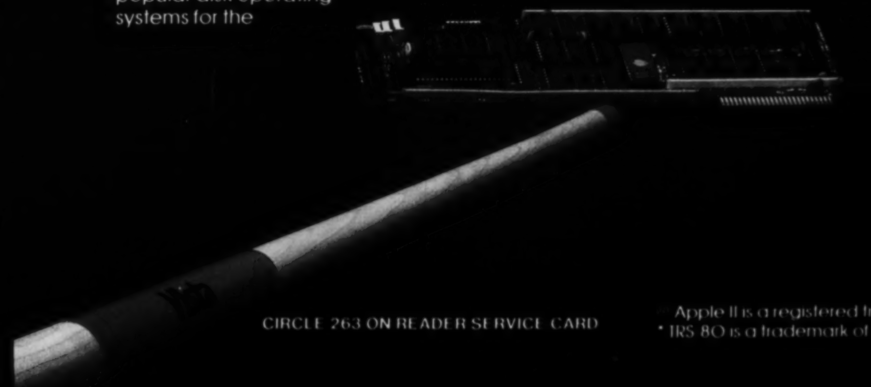

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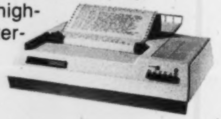

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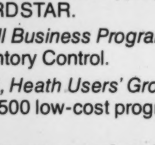

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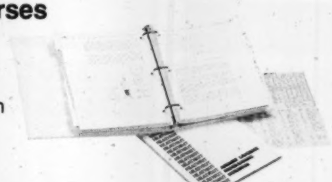

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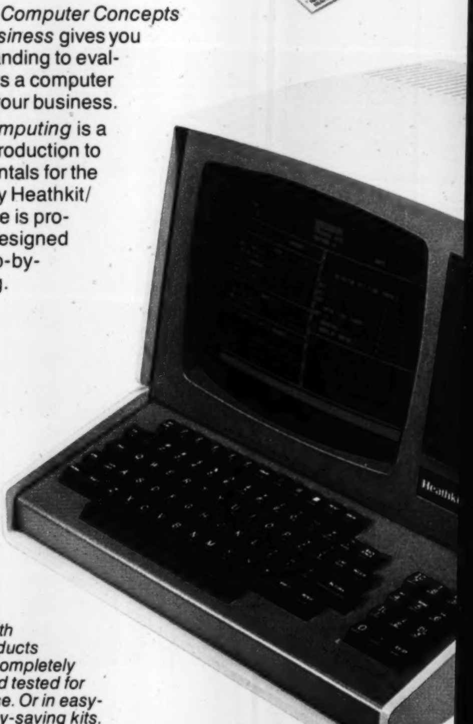

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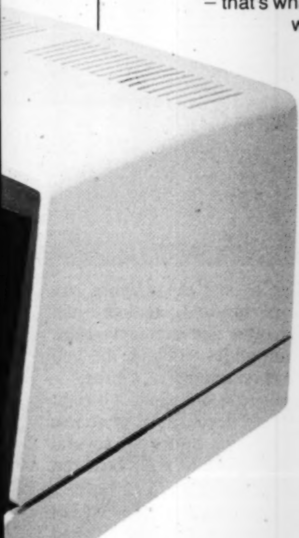

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I never expected to see a computer game this good—at least not so soon. Designed by Jay Sullivan (who also designed Hi-Res Football for On-Line), this game is a screamer. Rather, it's a cusser, especially when one of the strikers sends the ball floating toward your net and you send the goalie in the wrong direction.

Sullivan has designed it so that each player controls the movements of eight soccer players with the game paddles. The angle of an arrow drawn on the paddle determines the direction in which a figure runs. So your figures are constantly scrambling across the screen. I should have such boundless energy.

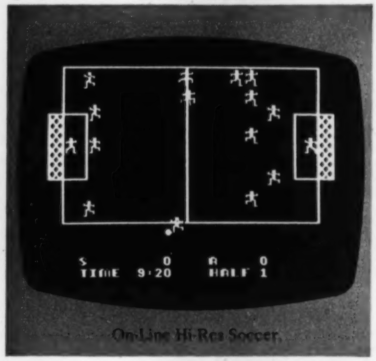
The player in the green jersey dribbled the ball down the field, deftly evading the rushes and lunges of his purple-clad opponents. At the last second, faking a kick to draw the goalie toward him, he passed the ball to a teammate who drove it between the bars for a score.

The player who has the ball dribbles it with his feet. The paddle setting also controls the direction of the kick—in one of 28 directions. With a little practice, you learn how to pass the ball back and forth between players; how to fake the goalie out; how to carom a pass into the goal off the sidelines in the beginner's game; where to have your goalie put a goal kick; and how to keep from being demolished by the Apple team in solitaire games.

To simulate balls being kicked into the air, some kicks can't be caught immediately: a rebound off the solitaire goalie delays one second, as does a throw-in when the ball is kicked out of bounds to the top or bottom (advanced game only). A corner kick occurs when a team kicks the ball out of bounds on the side of the field on which its goal is located; the opposing team gets to kick it in from the corner, with a two second delay. Finally, a goalie can kick with a two-and-a-half second delay if the opposing team kicks the ball out of bounds on his side.

There are three levels of play when two people play, one for solitaire play. At the beginner level, the ball bounces off all four sides of the field. For intermediates it bounces off the top and bottom but goes out of bounds to left and right, and in advanced play the ball can go out of bounds anywhere.

On color sets, the players are green and purple. On black and white, they're gray vs. black and white stripes.



On-Line Hi-Res Soccer.

It's hilarious to see the players run headlong across the field, steal the ball away from each other and intercept passes. The goalie even glides to catch the ball between his legs on attempted scores.

Don't expect to get the hang of it right away, either. I've been beaten by scores of 42 to 14, 24 to 6, etc. It took me several days of practice before I finally beat the game 5 to 3.

The game is divided into two halves of any length up to 45 minutes. The one bad thing about it is that there is no way to get a time-out to answer the telephone or any other call. □

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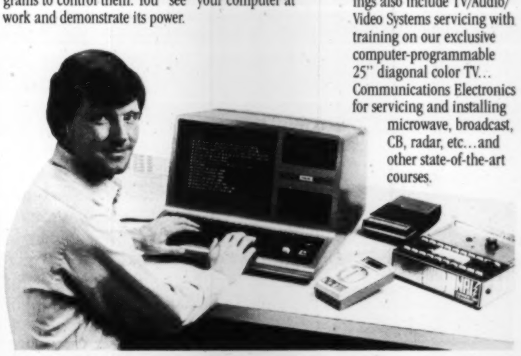

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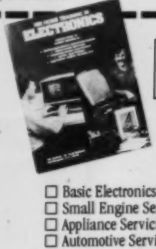

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SPORTS CORNER

creative computing software evaluation

Clockwise from lower left. John White, Bob Callan, Peter Fee, Owen Linderholm, and unidentified friend.

Owen Linderholm and John White

We recently received the Indoor Soccer module from Texas Instruments and being diligent, as we are, we immediately dropped the fun things we do around here, such as converting from the TRS-80 to the Atari, and put the game through its paces. Before too much time had passed, an Indoor Soccer Tournament had been scheduled. As they say, it's no picnic.

As word of this prestigious tournament spread, a number of All Stars signed up. The participants were Bouncing Bob Callan, Peter "Pele" Fee, the grizzled English veteran Owen "Legs" Linderholm, Jumping John White, Dave "Rock'em" Rogers, Giorgio Sternecker, and Dynamic Dave Lubar, who is odds-on favorite to win at any computer game we play.

Just the fact that we held a tournament with this game says something. It is, in fact, a heck of a lot of fun. The best way to describe it, however, is to let the winner of the tournament speak his mind. This interview took place in the locker room of T.I. Stadium, located within the spacious confines of our Software Development Center, and was conducted by that notable sports reporter, Warner W. Cosell.

W.C.: Hello again, everyone, this is Warner W. Cosell, speaking of sports. I'm here in beautiful downtown Morris Plains, where I have just witnessed a battle of monumental proportions. After scouring the world and even looking in the back room of our warehouse, the organizers of this tournament invited a few top athletes to compete in the first annual T.I. Indoor Soccer Tournament. The athletes all declined, so they dug up some of the characters who work at Creative Computing. After many gruelling matches, Jumping John White emerged as the winner.

creative computing
SOFTWARE PROFILE

Name: Indoor Soccer
Type: Sports Game
System: TI 99/4
Format: Plug-in Rom Module
Language: Machine code (9900)
Summary: Fantastic
Price: $29.95
Manufacturer:
Texas Instruments Inc.
P.O. Box 5012
Dallas, TX 75222

First of all, congratulations on a hard won victory. To what do you attribute your success?

J.W.: I was better than the rest.

W.C.: Seriously, though, how would you summarize this tournament?

J.W.: Well, almost all of the matches were close. Aside from Bouncing Bob, "Rock'em" Rogers and the great "Pele", everyone was pretty equal.

W.C.: Would you care to explain some of the details of the game?

J.W.: Yes.

W.C.: Would you elaborate on that?

J.W.: Since we didn't have the remote wire controllers, we had to use the keyboard controls, but they were surprisingly good apart from being a bit too close together for comfortable play. The controls manipulate a "Control Player," while the rest of the team operates independently under computer control. By attempting a tackle, one can switch Control Players.

W.C.: How about passing?

J.W.: Once the Control Player passes the ball, the receiver becomes the Control Player. This can set up some interesting passes off the walls and some tricky bank shots can be made.

W.C.: What I really wanted to know is whether you had any difficulty controlling the ball in passing and shooting. Could you tell our viewers about that?

J.W.: With a bit of practice you can be accurate on the great majority of kicks unless you are like "Pele" Fee, who is a bit of a slow learner.

W.C.: Judging from the tournament results this is a high scoring, offensive game and you're one of the most offensive players I've seen.

J.W.: I'm not quite sure how to take that remark, but actually I pride myself on my defense. I get as much of a thrill out of a nice interception or a good tackle as I get out of a goal. Interceptions are made by moving one of your players into the path of the ball. Except for the occasional fumble, he then gains control of the ball. Tackles are harder and involve

NEW!

SPACE ROCKS

By Steven Kearns

Alone in your spacecraft, you are exploring an uncharted area when your Tactical Display Screen suddenly blossoms with gigantic moving objects. It would be bad enough if they were ordinary asteroids, but their size and behavior tell you they are much worse—huge chunks of deadly antimatter, capable of destroying your ship on contact!

You fire your thrusters, hoping to escape the menacing onslaught, but here come more of the sinister shapes. You are surrounded, and the only way to avoid destruction is to fire your laser cannon. Aim . . . Fire . . . A direct hit! But instead of destroying the rock, your blast has exploded it into several smaller—but equally lethal—pieces. Now each must be separately eliminated.

The thought occurs to you that the sudden appearance of these rocks might be more than coincidence, and your suspicions are confirmed as time bombs enter the Tactical Display's field, their timer displays counting down toward your destruction! And finally the enemies themselves, in space ships firing antimatter torpedoes, join the fray.

Can you destroy or avoid the rocks and the enemy, and at the same time still the incessant ticking of the time bombs? With SPACE ROCKS, you can try. It's a realtime arcade game with sound effects to enhance the action. One or two players can compete, and there are five levels of difficulty to keep up the challenge as your skills increase.

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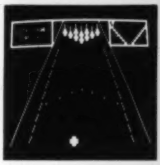


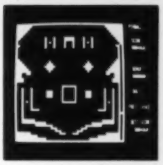
TENPINS

By John Allen

A realtime action game with 3-D graphics and sound, TENPINS brings the thrill of championship bowling to your TRS-80*

From one to four players participate, and the program senses the skill of each player. Beginners can simply "roll" the ball while more skilled players can vary the ball's force, direction, and spin.

TENPINS even has factors to simulate imperfections in the lanes, adding even more realism. Available for only $14.95 for 16K tape version, $20.95 for 32K disk.



PINBALL

By John Allen

Get your flipper fingers ready for action in this realtime, machine language game.

Lots of sound and flashing graphics make this fast action game so much like the real thing that you'll have to remind yourself not to shake your TRS-80. Choose from five playing speeds to match your skill. Can you beat your friends' scores? Will you avoid the infamous "Bermuda Square?" Get PINBALL today and find out.

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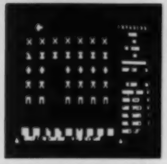

INVADERS FROM SPACE

By Carl Miller

A fast machine language approach to this classic (and addictive) space game. The aliens drop bombs, move around, and try to overrun your bases.

You choose the speed, enemy bomb frequency and accuracy, and how many shots and bases you have. Unlike other games of this type, you can move your base and simultaneously fire at the invaders. Fun for all ages and skill levels, it has full sound effects for even more excitement.

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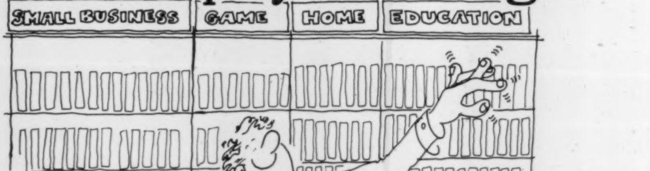

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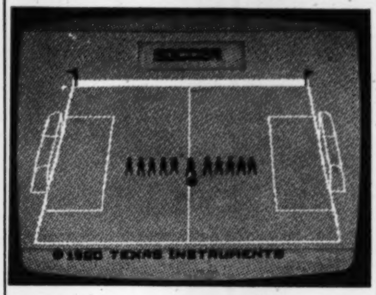
CIRCLE 166 ON READER SERVICE CARD

Sports Corner, continued...

good positioning as you attempt to kick the ball while it is in the other player's possession. You can succeed, fail or cause both players to lose control of the ball, depending on how skillful you are. The danger of playing tough defense is the potential for fouling. Giving away a penalty kick is an almost certain goal for the opposition. A good player can hammer home a shot in either corner of the net.



W.C.: Let's go to the videotape. A nice feature of the game is that you can do an instant replay of a goal. SWISH!!

J.W.: Nice goal!!

W.C.: Now that I've conducted the interesting part of the interview, let's go to my colleague, Earnest Glifford, to hear about the more mundane aspects of the game. Earnest?

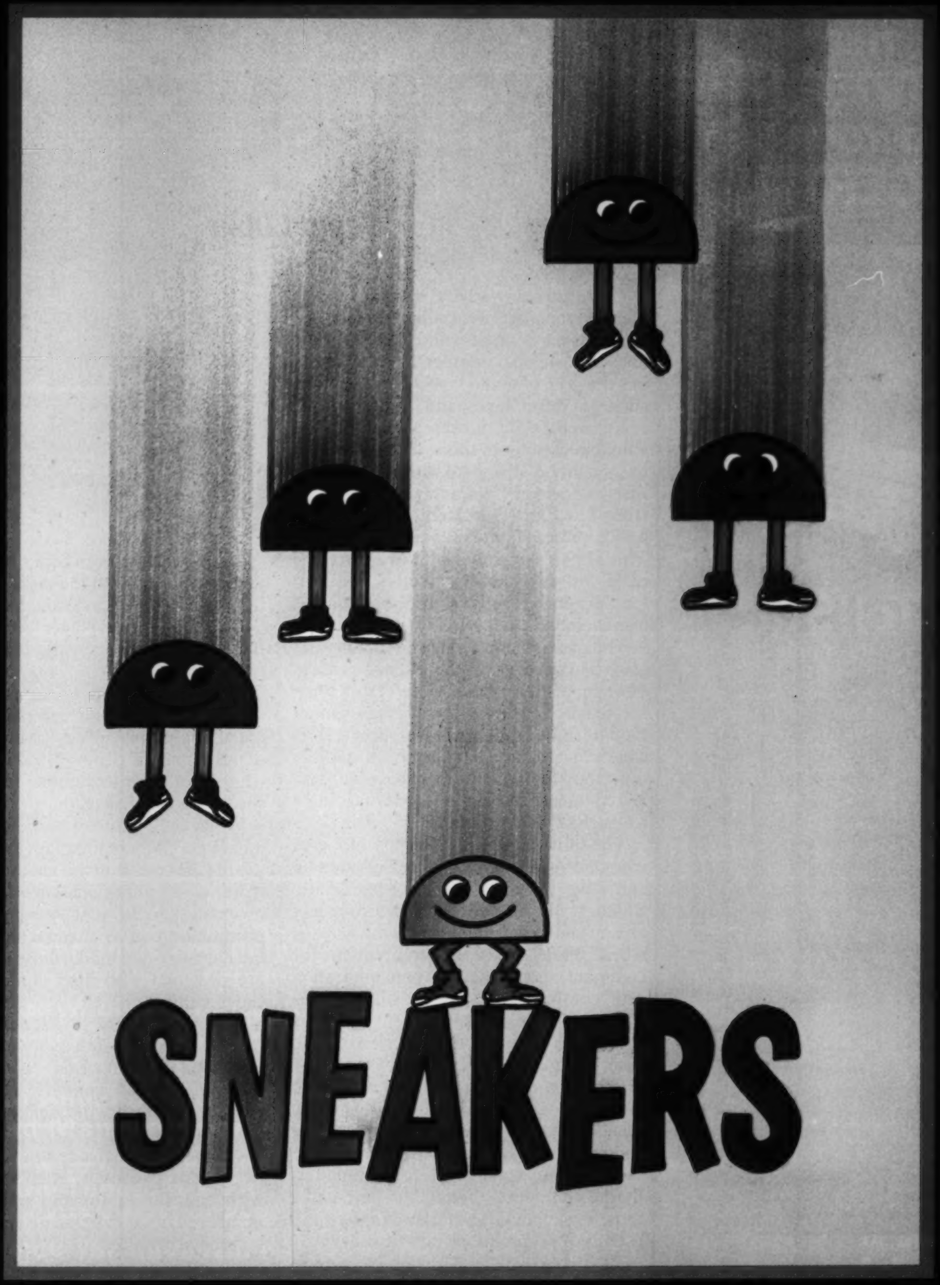
E.G.: Thank you, Warner. I was immediately impressed at the beginning of the game with the graphics and sound effects. It is also multi-lingual, has time-outs, and all the excitement of the real thing. The game costs $29.95 from Texas Instruments.

The main features are: keyboard or joystick control; passing; tackling; interceptions; replays; timeouts; multi-lingual capability (English, French, German, Italian and Dutch); 3-D high-res graphics; goal-kicks; penalty-kicks; free-kicks; blocking; interceptions; and sound effects (crowd noise, referee's whistle, musical encouragement).

Before signing off, let us have a moment of silence for Giorgio Sternecker, who was kidnapped just prior to the start of the tournament. He is now rumored to be on the trading block, with California a good bet. (a very short pause)...and now...

Thank you very much, John, nice having you here with us at Channel 2001 Studios. Now a break for a word from our sponsors, Creative Comp............. ☐

"Does thou love life? Then do not squander time, for that is the stuff life is made of."
Benjamin Franklin


SNEAKERS
What say we go out and stomp a few ???

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CIRCLE 242 ON READER SERVICE CARD

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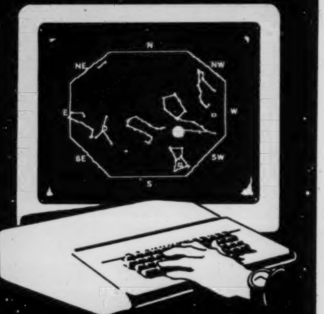

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CIRCLE 273 ON READER SERVICE CARD

Sliding

David Lubar

There are many ways to teach computer literacy, ranging from traditional lectures to hands-on courses where the software does the teaching. Between these extremes lies the area of audio-visual presentations such as video tapes and film strips. If done well, such presentations can be valuable classroom tools; if done poorly, they can be self defeating. *Basic: An Introduction to Computer Programming*, from **The Center for Humanities, Inc.**, is a slide presentation that is very well done. This $159.50 kit comes with two carousels of slides, two audio cassettes and two long-playing records. A teacher's guide is also included.

The cassette and record contain the same narration, giving the teacher a choice of equipment. Cassette is preferable since the teacher can stop for discussions and then resume at the correct point. The slide changes are cued with an audible tone, but the cassette can be used with any automatic projection unit conforming to the 1000-cycle standard.

The show starts with the story of a man who finds a genie in a bottle. Told that he can have a wish, he speaks his desire, which is interpreted literally, producing an amusing result. This opens the way for a brief discussion of the requirements for communication, especially communication with computers. Soon, the student sees examples of program statements, and has received a painless introduction to the Basic language. The first part of the presentation covers simple commands such as PRINT, LIST, GOTO, and IF-THEN. The concept of a variable is also introduced and explained. If presented without interruption, this segment lasts for 36 minutes. By the end, most students should be able to write simple programs and understand listings of programs written by others.

Part two introduces the student to flowcharting. This important technique is a strong aid to logical thinking and, in turn, an aid to developing a sound programming style. More Basic statements, such as READ, DATA, and INPUT, are introduced, giving the student a full arsenal of commands for programming. Part two also steps through the complete development of a program for determining batting averages (perhaps a more universal application would have been better here). Rather than jump right into the task, the student first sees a simpler program that computes an average for one player. After this, the final program is constructed and analyzed.

The entire presentation earns high marks for clear and effective material. The slides are of professional quality, as are the voices of the narrators. Drawings are interspersed with slides of programming text, helping to avoid a boring session.

While each part can be viewed without interruption, there are many points where the teacher can stop the audio and discuss material or allow students to try their own solutions to questions posed by the presentation. The manual contains the full narrative and marks those slides which are designed with high contrast. These slides can be viewed with the lights on, allowing students to take notes, and teachers to make sure everyone is paying attention. The manual also contains a series of exercises and answers, allowing the teacher to extend the concepts beyond the slide show.

On the technical side, the slides are in two Kodak carousels. Each set is striped with a color code, and each slide is numbered, so accidental disorderings can be easily corrected. The set comes with a lifetime-replacement guarantee. Any portion which is lost or damaged will be replaced for free. This is a generous gesture on the part of The Center for Humanities. The package would make a fine addition to any school's collection of audio visual material.

For more information, contact The Center for Humanities, Inc., Communications Park, Box 1000, Mount Kisco, NY 10549. ☐

CIRCLE 230 ON READER SERVICE CARD →

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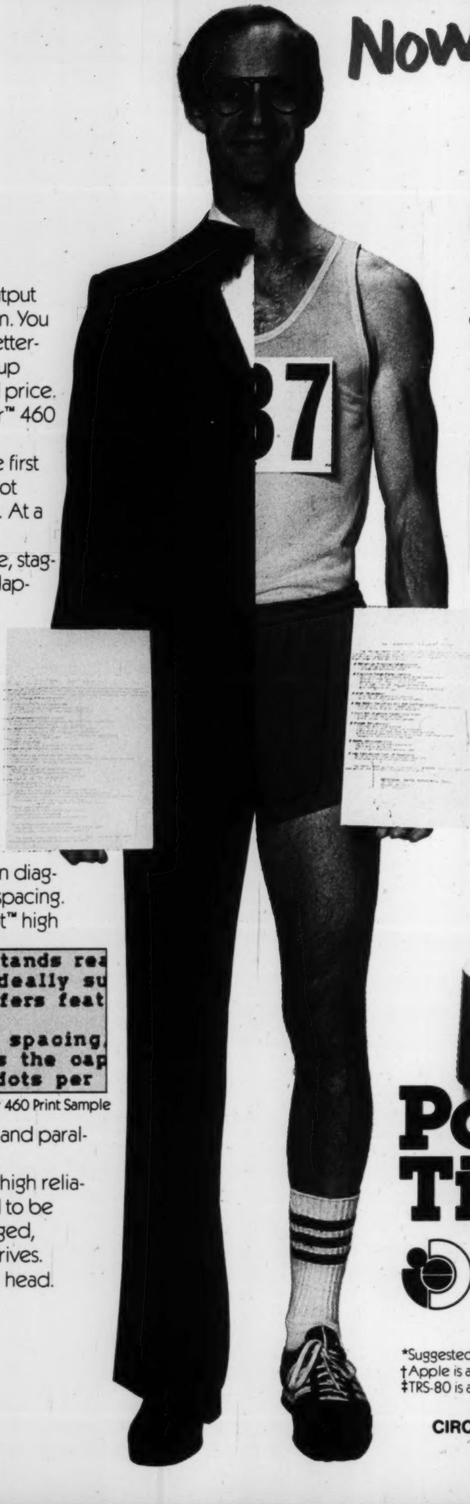

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*Suggested single-unit U.S. retail price.
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‡TRS-80 is a trademark of Radio Shack, a division of Tandy Corp.

CIRCLE 293 ON READER SERVICE CARD

APF Mathemagician

David H. Ahl

APF's Mathemagician is a teaching calculator designed to help sharpen basic or intermediate arithmetic skills. In addition to being a calculator with all the basic math functions, it plays games. The electronic games include: Number Machine, Countin' On, Walk the Plank, Gooey Gumdrop, Football and Lunar Lander. Most of the games can be played by one or two players and some are timed to test skill levels. Of course, the Mathemagician will let the player know if his answer is right or wrong. Mathemagician features an LED display, large keyboard, and plastic overlays for each game.

The Number Machine game helps younger players develop number recognition skills. The object of the game is to key in the same number that is displayed at the beginning of the round. Countin' On is a counting game. The Mathemagician will count by 1's or skip count by 2's, 3's, 4's, etc. You count along and then key in the number when the counting stops. You get a point each time you are right.

Walk the Plank is a guessing game. You get three tries to guess the secret number before you go "byby.". Gooey Gumdrop is a game where the player must locate a Gumdrop hidden in a 9 block by 9 block area of Gotham City before it blows up. (Gooey Gumdrop is a hand-held version of Hurkle.) Football is a game of mathematics practice. When you call a play the Mathemagician will give you a problem. Answer correctly, and the ball moves closer to the goal line. If your answer is wrong, no gain. Good play will eventually score a touchdown. The rules are similar to regular football.

In Lunar Lander the player attempts to land a rocketship on the moon safely. The player starts out at an altitude of 300 feet in a LEM which is dropping toward the surface of the moon at a speed of 20 feet per second. The player has 99 units of fuel. The object is to select the right amount of fuel on each burn (one per second) to land safely.

Mathemagician, made by APF, has a suggested retail price of $29.95. (For an in-depth review, see *Creative Computing*, March 1978.) □

THE
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I.
INSPECTOR
by
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D

PROGRAMS FOR PRESCHOOLERS: STARTING OUT YOUNG

Stephen Kimmel

IT'S MORE FUN THAN A THREE-RING
CIRCUS

In my early days with the personal computer, I took the company's computer home (note: this is the cheap way to get started with home computers—get somebody else to buy one) and slaughtered Klingons by the thousand. But none of their maneuvers terrified me as much as hearing the pitter patter of little feet and feeling the tug on my shirt sleeve. Reluctantly I would look down to see my 18-month old son, Robert, smiling beatifically. Has anyone heard words more certain to freeze your blood than "Daddy, I wanna play compooter?"

"No, you slimy little brat! This is my toy and you can't have it!" I screamed in my mind, and almost instantly felt remorse. I could give the kid a complex of some kind. He would be traumatized, fail in school and life, become an axe murderer and kill me one night as I vanquished Klingons for the eight jillionth time. Not a pretty picture.

"No. This is too easy to break," I thought. That, too, sounded terribly lame.

"Sure. Why not? After all I didn't buy it," I thought. That was the clincher so I smiled, reached down and lifted him onto my lap. Robert's response was immediate and exuberant. Pound. Pound. Pound with both hands on the keyboard. "No. No. Push the keys. Don't pound on them."

Push. Push. Push. Pound. Pound. Pound.

Three hours later, after I had finished cleaning the jelly from my computer keys, I paused to consider the situation. Kids, it seems, are interested in whatever interests you. If I was going to have the computer at home, I was either going to have to lock it and me in a room or play with it only at night. Or I was going to have to find something Robert could do with it.

Kids, it seems, are interested in whatever interests you.

For a while Robert was satisfied with simply pushing the keys and watching the letters disappear off the top of the screen. After only a month or two that got old. Then I began my search for software suitable for a preschooler.

It is worthwhile to consider the qualities of preschoolers that make them unique in the computing population. This will provide us with some key information about why one program is good while another isn't. Without this fundamental baseline we are floundering along with little adults; a concept that is simply wrong.

First and foremost, preschoolers can't read. This is almost the definition of a preschooler. So obviously the program can't have written prompts. Rewards and punishments can't be in plain English. This sort of communication occurs to us, as programmers, first because it requires the least thought on our part and we are comfortable with it. Preschoolers, however, make it impossible. All of the communication between the computer and the preschool operator has to be nonverbal. Fortunately, there are many other ways to communicate. To use them requires more planning and greater skill on the part of the programmer.

The most important means of nonverbal communication is visual. Almost all home computers are capable of reasonable graphics. Even the TRS-80 can generate a face that the youngest of preschoolers can recognize. The infant learns to recognize faces and facial expressions as communication almost before it learns anything else. Using this in a program requires no great skill. You simply show a smiling face when the child has done the right thing or a frowning face when the answer is wrong. Some of the programs reviewed take that one step further and have the head nodding approval or shaking to signify no. Everyone understands that.

Sound can be a very important part of communication. Needless to say, most

---

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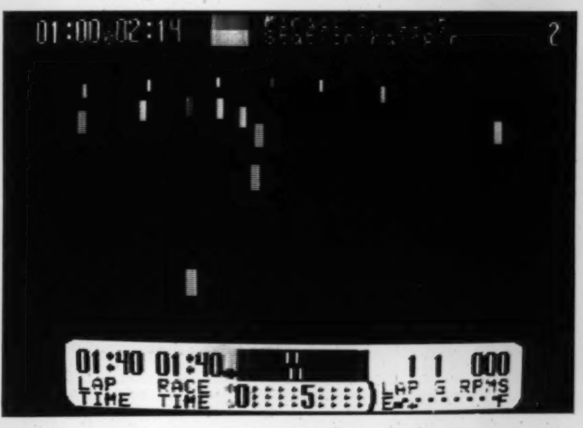

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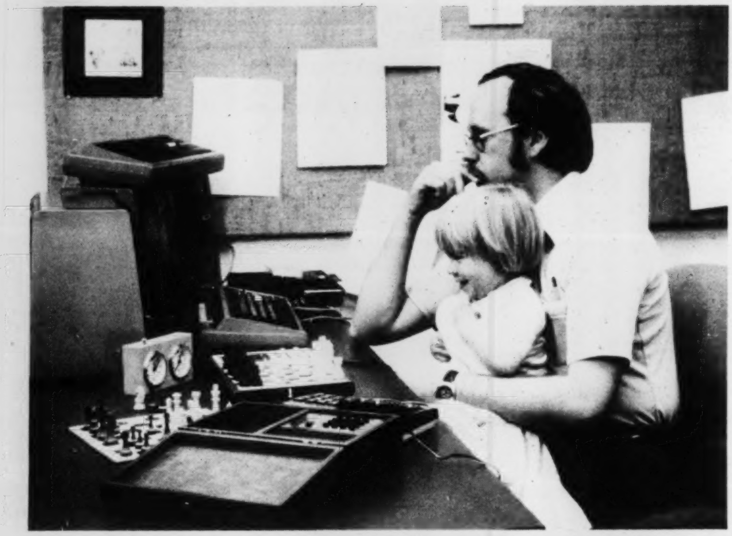

Robert at 18 months during the first Creative Computing *Chess Tournament. A big help.*

preschoolers understand the spoken word long before they can read. The sound of something—an explosion, a musical tune—communicates as effectively as printing "Your ship has been destroyed by the Klingons."

The second key characteristic of preschoolers is that they don't have well developed problem-solving skills. In most cases it is probably valid to define a game as competitive problem-solving. Most younger preschoolers don't understand the concept of "game." Let a group of two-year olds play in a room and you have a room full of two-year olds playing by themselves. There is no sense of cooperation or playing together.

One of the recommended "games" for young children is to have them stick baby food jar lids through a slot. It is, for the very young, a staggeringly difficult task. Thus we can eliminate the majority of the traditional games.

The preschooler can only understand simple cause and effect. If I do this, it does that. Push the bowl, it falls on the floor. And even that was a surprise not too long ago. The level of depth to which they think ahead is quite limited. The preschooler's game has to be very simple with immediate results for actions.

Third, the preschooler hasn't developed particularly good coordination yet. One finger at a time is about all he can handle. Certainly anything requiring the hands to be doing different things simultaneously is beyond preschoolers. It's a skill I developed when I was about 12.

The preschooler doesn't react quickly. Even older preschoolers seem to have rather slow reaction times. So games that require moving quickly aren't very good either. The problem is that the child is easily frustrated at his own inabilities, and the experience can become an unhappy one quickly.

The class of games that comes to mind immediately is the arcade type game. To challenge an adult requires quick actions, frequently with both hands. The preschooler will be attracted to this sort of game, but won't be able to play.

It is necessary to address the issue raised by Sally Greenwood Larsen in her book Computers for Kids. She states, "I can't emphasize this one enough. Don't ever let your children play commercial game tapes until they are accomplished programmers! By 'accomplished' I mean the end of the first year (of programming classes) for most children."

Robert at 3 1/2 years is a seasoned veteran who knows what computers are for—fun!

Her argument is that kids exposed to the fun of the slick commercial games will lose all interest in programming. She also states that the only games a child should be allowed to play are the ones he has programmed himself. The effect of this is that no preschooler should be allowed to play with the computer since the earliest he can be expected to be an "accomplished programmer" is about five years old.

The argument is specious. It is akin to saying children shouldn't be allowed to read the classics until they are accomplished writers. Most educators agree that the children who become the best readers, the best students, etc., live in homes filled with books. The parents show respect for books, read frequently and begin to read to their children regularly at an early age—sometimes before the end of the first year.

Reading begins as a close, comfortable sharing experience long before it has any significance as a conveyance of ideas. How different is sitting on your father's lap listening to a book from sitting on your father's lap playing a computer game?

There are differences, and the most obvious is that in one activity you are passive while in the other you are actively affecting the outcome. More important, however, are the similarities. You are warm, have a good feeling about yourself, your father, your book and your computer.

Interestingly enough, it is the good readers who become the good writers. All the professional writers I know are voracious readers. They have a love affair with words and it doesn't seem to matter whether the words are coming in or going out. Almost none of them were "accomplished" writers until their teens. Some didn't become competent writers until much later in life. The fact remains that all of these professional writers were good readers at an early age and all started their contact with books long before they learned to write.

I suspect that almost all of Miss Larsen's students come from homes without computers. Her experience must be similar to teaching students who have never seen a book to read and write. Her students may eventually become competent programmers and be able to use the computer to good advantage as adults. Will they become great programmers? Will their programs become classics? Did Shakespeare's mother read to him as a child? I don't know. But I firmly believe that the preschooler who learns to love and respect the computer before he can program will ultimately be better for the experience.

I'll begin the review of some programs that might be suitable for preschoolers by

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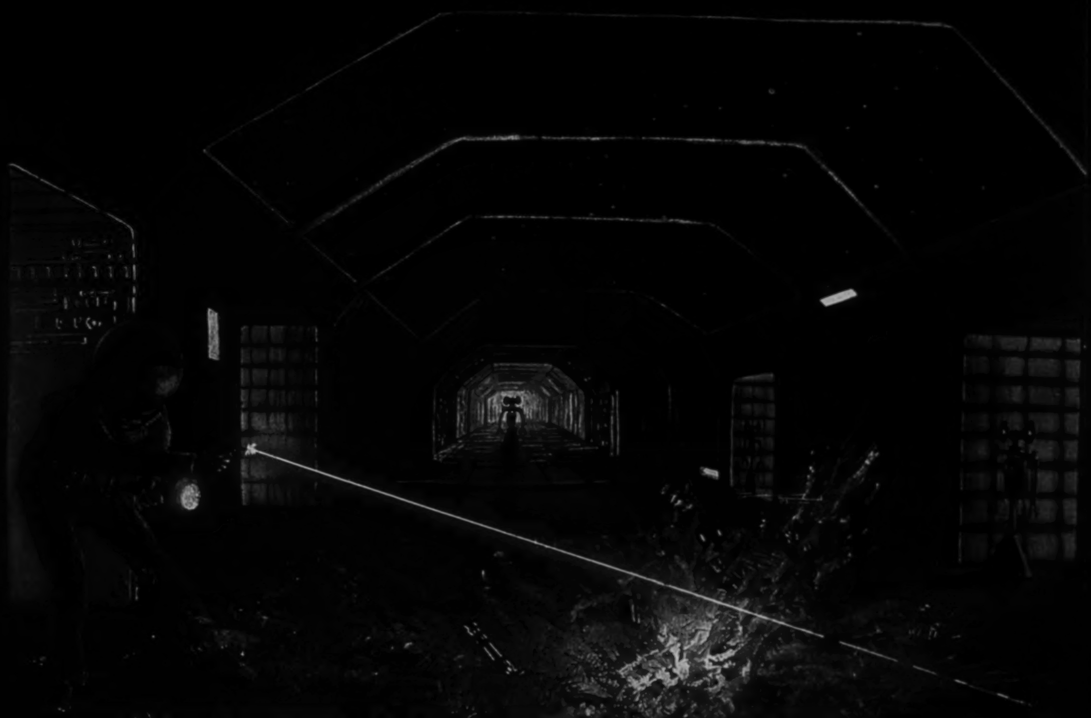

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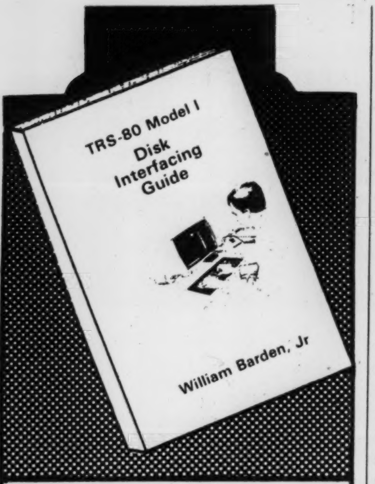

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Preschoolers, continued...

reviewing the qualities we want. It should make extensive use of nonverbal communication. It should give immediate results to actions and require no great amount of strategic planning. It shouldn't require great speed or coordination. Like any program, it should be reasonably priced and free of bugs. Where do you find these programs?

Nine Games

Robert's favorite computer game and, in my opinion, the creme de la creme is George Blank's Nine Games for Preschoolers. I mention it first because it was about the first attempt at designing a computer program for the personal computer with the preschooler in mind. This is probably the first program you'll turn to when you start looking for software for your preschooler.

George got just about everything right. There are others who have done some of the things better than this early effort, but none have combined the qualities as well for a package of solid value.

As all you highly perceptive types have already deduced, there are nine games in the package. Letterfun allows the preschooler to type in a group of letters. He then presses enter and the letters do amusing things such as bounce around, explode, and march from side to side across the screen. While this may not seem like much, it will amuse a young preschooler for some time.

ABC has a little face that smiles when you type in the right letter of the alphabet and shakes its head when you type the wrong one. Sometimes getting the shaking head is funnier than the smile so there will be times when the preschooler will intentionally push the wrong key.

Letter Wars is a drill on small letters that pauses every ten letters for a brief space battle. The outcome is determined by whether you got the letters right or not. The graphics here are nothing to write home about, but they are adequate. By age three, Robert was getting over 98% and playing 100 letters at a sitting.

Repeat is a game for much younger children. Here the key pushed is repeated 32 times across the screen forming patterns.

Names provides practice in recognizing names in the middle of text. You type in six names which are repeated in random order filling the screen. It pauses and you and your child pick out individual names.

Blackboard is just what it says. What you type appears on the screen. Troll's Gold is a maze in which doors open and close. Your mission is to get the troll's gold and get out before he catches you and eats you up. If you escape, the screen is filled with dollar signs. If you get caught the troll's mouth slams shut on you. Each game takes about eight minutes, and Robert will play three in a row.

Math Drill is a drill in addition and substraction. Counting blocks are displayed, too. Calculator is a four-function calculator with the display in standard school format. Not a whole lot of fun.

One extremely nice thing about Nine Games for Preschoolers is that all of the games are in memory at the same time. The programs are called from a master menu that doesn't require reading. Pressing the clear key during a game will return the preschooler to the main menu. Part of the strength of the program lies in the fact that the games call for different abilities, and the child will grow out of some and into others.

The net effect is that this program won't be quickly discarded. Educational, well designed, good play. Yep. This program is probably the best. At $9.95 from the TSE this program is an absolute must for anyone with a 16K TRS-80 and preschoolers.

The Software Exchange, 6 South St., Milford, NH 03055.

Dancing Demon has the best graphics I've seen on a TRS-80.

Android Nim

Android Nim by Leo Christopherson, who I am secretly convinced has elementary school age kids, is an example of a planning game that is still good for preschoolers. Christopherson is the acknowledged master of low resolution graphics and Android Nim is an excellent combination of animation and sound.

The strength of the game is in its action. Instead of beans or sticks, the game is played with small robots. They fidget nervously and chatter, which holds the child's attention. After you've entered the number of androids you want to remove, a leader android "looks" to check if your move is legal.

It either "speaks" to affirm your choice or shakes its head to tell you that the move is illegal. Given a legal move, the leader pulls out a ray gun and disintegrates the appropriate number of androids. If the computer wins, it pronounces its victory in large letters. If it loses, the leader robots hang their heads.

Android Nim has action and effective use of nonverbal communication, and requires no great coordination. It does require careful preplanning, if you're going to play it right. However, it can be used as a counting game and as such has some educational value. Preschoolers will enjoy it—at least until they discover that "I

WIN" means that they lost and the computer won.

Android Nim is available from 80-US, 38 South Warner, Tacoma, WA 98409.

Dancing Demon

Radio Shack has only two programs suitable for this age group. Dancing Demon may very well earn Leo Christopherson eternal glory. I am amazed at the man's ability. The name of this program is completely descriptive. You program in a song and the demon's dance steps, select a speed and play it all back. On the preschool level this is simply a matter of randomly pushing keys. It does have two prerecorded song and dance numbers and the ability to record your creations. As such it will amuse the preschooler somewhat longer than simply pushing keys and seeing what letters appear.

Dancing Demon has the best graphics I've seen on a TRS-80. The program makes no attempt at nonverbal communication and has no significant educational value. If you want lasting use with your preschooler you'll have to be ready to type in some familiar songs that you can sing together. This program is really for adults who want a cheap ($9.95) introduction to music generation and something to show off their computer. As my local Radio Shack dealer told me, Dancing Demon is a store demo.

I haven't seen Radio Shack's Show and Spell so I'm not really qualified to comment on it. However the review in the March '81 *Creative Computing* was enough to persuade me to cancel my order.

Kidventure

Kidventure 1, Little Red Riding Hood, was written, or at least sold, as a preschool version of the immensely popular Adventure series. Many things about it are very well thought out.

The program comes with two sets of keyboard masks on heavy cardboard that you cut out and color if you like, and use to relabel the keys. This is an interesting and very effective way of overcoming a preschooler's inability to read. When the preschooler wants to answer "Little Red Riding Hood," he simply pushes the key indicated by the picture of the little girl—which happens to be the up arrow. There is almost no possibility of mistaking Grandma for Little Red Riding Hood.

The program also comes with an audio cassette of, presumably, the author and his family reading the story of Little Red Riding Hood. The author raps a spoon against a glass of water and this is the preschooler's cue to press the space bar and advance the story. The screen changes to show the next group of words and a crude graphics picture. This is the program's story mode and what it amounts to is a bad and very expensive picture book.

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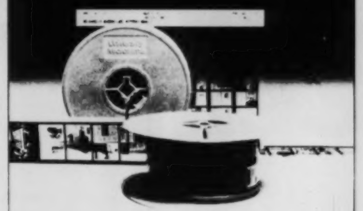

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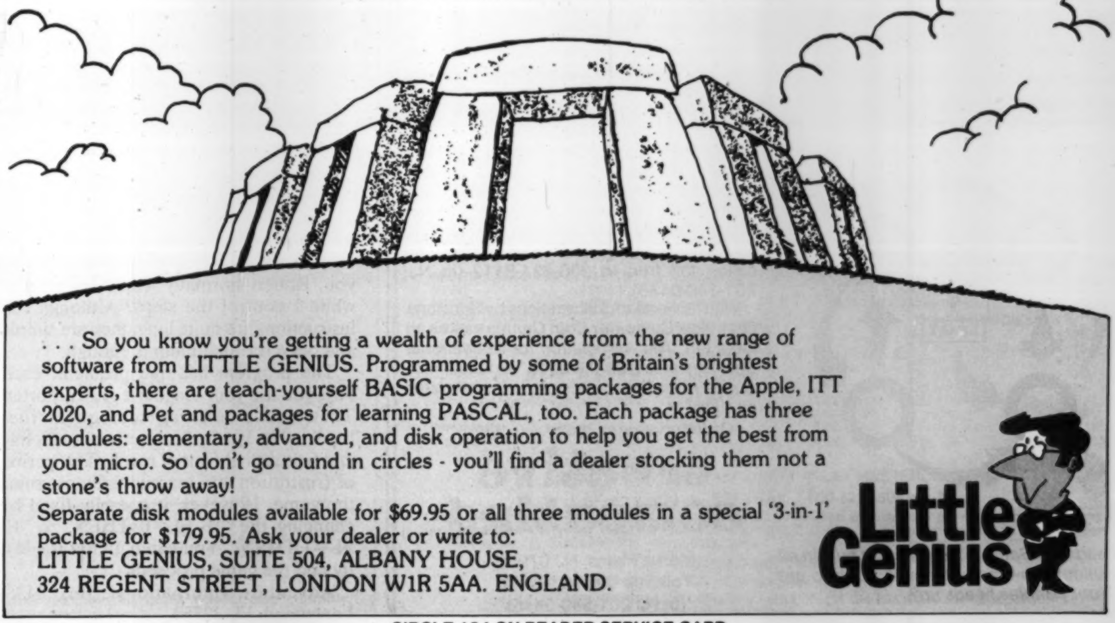

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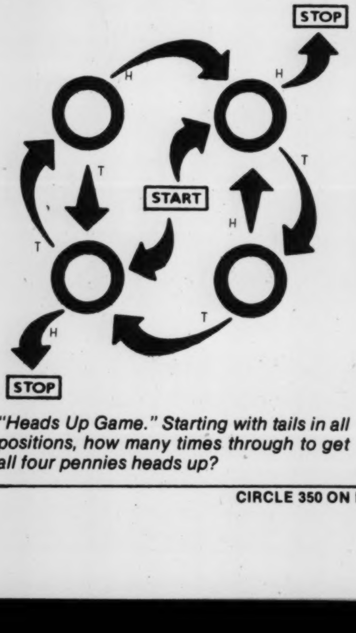

"Heads Up Game." Starting with tails in all positions, how many times through to get all four pennies heads up?

CIRCLE 350 ON READER SERVICE CARD

Preschoolers, continued...

In the quiz mode the program tells the story and periodically stops to ask a question. When the child answers correctly, the story proceeds. In the quiz mode the program plays appropriate (?) little tunes for each major character and item. Such as "Who's afraid of the (Big Bad Wolf)," "Jeepers, creepers, Where'd you get those (eyes)" and "I've been working on the railroad" for the woodcutter.

Alas, the quiz is no challenge to anyone, including any preschooler who is familiar with Little Red Riding Hood. Robert only missed one question the first time through and I think he was joking ("But Grandmother, where did you get those great big (Beds)"). Robert has only asked for Kidventure twice since the first day.

Frogs

Frogs is another game from Adventure International designed with kids in mind. Here you are a frog sitting on a log floating in a pond trying to catch flies with your tongue. The left arrow and the right arrow control your steps to either side. The frog will shake his head and croak at you if you try to step off the log. Up arrow will shoot your tongue out to the left while the Q key shoots it to the right. When the frog catches a fly it goes through a cute routine of chewing it up. (Robert learned that frogs eat flies from this program.)

There is almost no possibility of mistaking Grandma for Little Red Riding Hood.

After you catch all the flies, the frog thanks you and your score is displayed. The action is good, and demands no great speed or coordination despite requiring both hands. It is easy to play with two of you. Robert normally works the tongue while I control the steps. Although the instructions are quite long, they are simple and once through them is enough.

The program has one problem: each time you use your tongue, it grows shorter. That makes catching subsequent flies harder. The last fly floats around randomly and frustratingly out of reach. This period of frustration and inactivity almost ruins the game. However, it is easily fixed by changing the "IF FL=0 THEN" to "IF FL=1 THEN." You catch all but the last fly and the game proceeds.

Adventure International, Box 3435, Longwood, FL 32750.

Galaxy Invasion

High on Robert's list of favorite programs is "Galaxy Invasion" by Big Five Software. This is the TRS-80 version of the arcade Galaxians. Here you use a mobile rocket base to shoot dive bombing invaders. If they hit you with a bomb or crash into you, you're dead. You use the left and right arrows to move the base and the space bar to fire the rockets. The graphics are good and there is extensive use of sound. It is, however, well beyond the average preschooler's coordination.

Normally we overcome this problem by having Robert shoot while I control the motion of the base. I get the hard part. It's a lot of fun and the child's enthusiasm is contagious. Together we routinely get over 30,000 points. This game is exciting and both preschoolers and their parents will love it.

Big Five Software, P.O. Box 9078-185, Van Nuys, CA 91409.

There are many programs available for the youngest members of the computer society; I've just barely scratched the surface. I haven't even tried to review the overtly educational programs and I'm sure there are many fine ones. If you know of any that are particularly good, please tell me about them. Other arcade type games such as Super Nova, Space Invaders, and Star Pilot should also be good for combined play. The jury is still out on Acorn's Pinball.

So there is no reason at all to hide your computer from your munchkins. Why not start them in computers the right way? Unless, of course, you really mind cleaning jelly off keyboards. ☐

"The fixed person for the fixed duties who in older societies was such a godsend, in the future will be a public danger."
Alfred North Whitehead

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String/80 (source)	$279/$na

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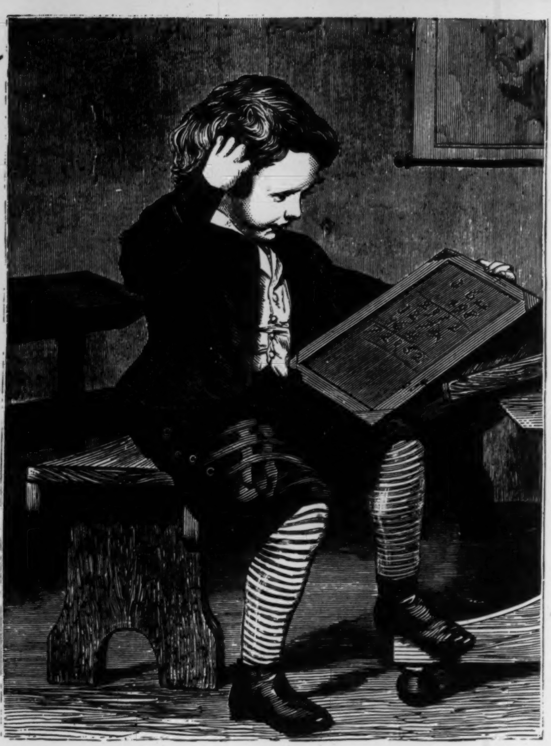

creative computing software evaluation

Educational Software and Books

David Lubar

Almost every software house in existence seems to be producing something for the educational market. Since it is impossible to cover every program, we have chosen a random sampling of software to review; some of the programs were requested from the manufacturers, others came in unsolicited.

On the Dotted Line

Sentence Diagramming gives a good presentation of a difficult subject. This Apple disk was developed using the ZES authoring system which, along with several other authoring systems, will be reviewed in a future issue. The diagramming program offers the teacher a selection of options for each student, such as level of difficulty, percent correct before moving to the next level, and whether to present only the question part and skip actual diagramming. The program contains twenty sentences for each of three levels, each level has four segments, any one of which can be used by itself in the classroom.

In the first section, the student must determine the part of speech for each word in a sentence. If a mistake is made, the correct answer is shown. Once all the words have been classified, the student is given a chance to pick the usage for words and phrases. Since this is more complex than picking parts of speech, the student has the option to select only those with which he is familiar, and to move to the next section at any time. In the third segment, the student must identify the sentence type. Finally, he gets to the diagramming portion. This segment puts an unfilled diagram form on the text screen. The student must fill it in with the correct words from the sentence.

If the teacher selects the record-keeping option, he can see a student's entire record, or the latest record for each student. The record contains the level and the percentage score of the student. It should be mentioned that this particular program is for drill only; it doesn't provide tutorial material. But for what it does, *Sentence Diagramming* is a good presentation of a tough subject.

creative computing
SOFTWARE PROFILE
Name: Sentence Diagramming
Type: CAI English
System: 48K Apple, ROM Applesoft, Disk Drive
Format: Disk
Language: Basic
Summary: Can be used in whole or in parts to teach grammar concepts.
Price: $19.95
Manufacturer:
Avant-Garde Creations
P.O. Box 30160
Eugene, OR 97403

For the Very Young

Sammy the Sea Serpent is a computerized story book for children ages 4 and up. The program combines graphics on the Atari with an audio track on the cassette to tell the odyssey of Sammy. The child interacts by means of a joystick, guiding Sammy through mazes, helping him catch flies, and moving him from one story segment to the next. While the program helps develop eye-hand coordination, its main function is to act as a storyteller. It succeeds in this task. The flip side of the cassette contains two games that can be played with Sammy. The games (one where the player leads the serpent through a maze and the other where the player helps Sammy catch flies) appear in the story, but can be played repeatedly by themselves. Though no replacement for a human storyteller, *Sammy the Sea Serpent* is definitely a step above Saturday morning cartoons. Parents who are concerned whether the program will be used more

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SOFTWARE PROFILE
Name: Sammy the Sea Serpent
Type: Entertainment
System: 16K Atari, Joystick
Format: Cassette
Language: Basic
Summary: Interactive picture story.
Price: $16.95
Manufacturer:
Program Design, Inc.
11 Idar Ct.
Greenwich, CT 06830

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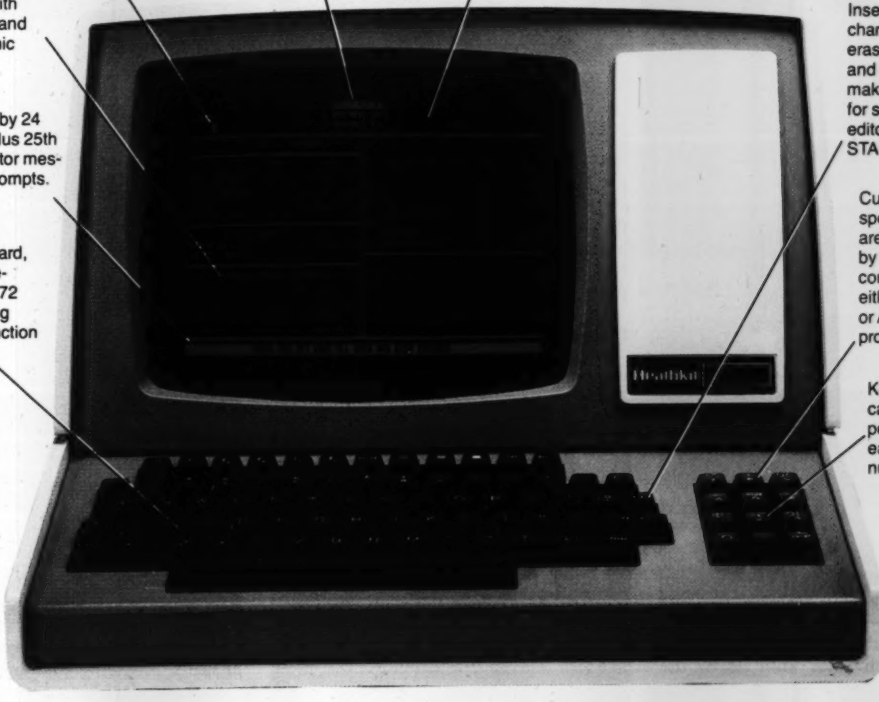

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*In kit form, F.O.B. Benton Harbor, MI. Also available completely assembled at $995. Prices and specifications are subject to change without notice.

CP-202B

than once should remember how often children will sit through a rereading of a favorite storybook.

Rewarding Figures

The Math Machine takes drill and practice a step above the usual drudge level. This Apple disk contains a full system including record-keeping capabilities. At the start, the user is asked for a password. If a student is using the program, his password starts the drill. The teacher's password gives him access to the options menu. Here, he can add or delete a student from the files, review records, obtain a list of students, or change a student record. To make an assignment, the teacher first selects from one of seven categories, which range from pre-math for kindergarteners to multiplication for 7th grade and above. The program then lists and describes the levels within the category. Pre-math has the fewest with nineteen levels, addition has the most with 29 levels. After selecting the desired level, the teacher selects the number of correct answers the student is required to make before receiving reinforcement. This reinforcement is in the form of games. Whenever the student has achieved the required number of correct answers, he gets to select from a menu of six games. The games, while not of arcade quality, are adequate for reinforcement purposes.

The math problems are presented with large lo-res numbers. If any problem is missed twice, the correct answer is displayed. The program does not provide any help or branch to different difficulty levels. The student can keep going as long as he desires, or until he or the teacher hits escape. The student record contains the category and level, along with the number of problems attempted, the number correct, and the number of reinforcements. While not perfect, *The Math Machine* seems to be a good presentation of drill and practice.

creative computing
SOFTWARE PROFILE

Name: The Math Machine
Type: CAI Math
System: 48K Apple with ROM Applesoft, Disk Drive
Format: Disk
Language: Basic
Summary: Well-designed math system
Price: $79.95
Manufacturer:
SouthWest EdPsyche Services
P.O. Box 1870
Phoenix, AZ

Good Grammar

Instead of drill and practice, the format of *English Usage Exercises* seems to be explain and drill. These programs for the TRS-80 contain approximately one hundred short sessions per disk. Each session begins with an explanation and examples of a concept, followed by questions. The entire set consists of four volumes. Volumes I and II were available for review. Each session sticks to a specific topic, such as verbs ending with "ing," or sentences with double subjects. The scope and variety of the lessons provides teachers with a tool that can be used either as a whole or in portions. The only problem is that the computer, aside from immediately telling whether the answer to a problem is correct or not, provides nothing that can't be obtained through a workbook. It does provide ready-made drills that are convenient to use, but seems to be an adaptation of the computer to traditional techniques rather than an adaptation of techniques to the capabilities of the computer.

creative computing
SOFTWARE PROFILE

Name: English Usage Exercises
Type: CAI English
System: 48K TRS-80, Two Disk Drives
Format: Disk
Language: Basic
Summary: Extensive set of grammar programs.
Price: $149.95 per volume
Manufacturer:
3R Software
P.O. Box 3115
Jamaica, NY 11413

Quizzer

Though outwardly a game, *The Wizard* has the potential to turn the TRS-80 into a fun teaching device. The program presents a quiz game for from one to four players. In turn, each player is given a question with four possible answers. If he chooses the correct answer, he receives a predetermined number of points. The twist to the game is that players can steal a question. A successful steal earns double the point value. If the thief answers incorrectly, he loses double. The educational aspect comes from the ability to create sets of quizzes. Up to six quizzes can be stored on a disk, and up to 100 questions can be entered into each quiz file. With this capability, the program can be molded to suit almost any classroom situation. As another plus, *The Wizard* is one of the few programs on the market that allows four people to use one computer at the same time. And the price is hard to beat.

creative computing
SOFTWARE PROFILE

Name: The Wizard
Type: Game
System: 48K TRS-80, Disk Drive
Format: Disk
Language: Basic
Summary: Fun and potentially a good educational tool
Price: $19.95
Manufacturer:
Programs Unlimited
P.O. Box 265
Jericho, NY 11753

Reading the Meter

Metric System Tutor is a comprehensive set of lessons and drills covering the metric system. This Apple program begins with a pretest that determines which topics the student needs to cover. Each section mixes instruction with questions, producing very good lessons. The computer is used to its fullest; hi-res graphics and sound are an integral part of the program. The first section, Intro to Metric, covers the development of linear and volumetric units. The next section covers conversion of common units. Following this are two sections for converting to very small and very large units. Last, there is a final test that contains questions covering all the topics.

creative computing
SOFTWARE PROFILE

Name: Metric System Tutor
Type: CAI Math
System: 48K Apple, ROM Applesoft, Disk Drive
Format: Disk
Language: Basic
Summary: Excellent use of the computer as tutor.
Price: $59
Manufacturer:
Cygnus Software
8002 E. Culver
Mesa, AZ 85207

The program responds well to incorrect answers, providing additional help whenever the student has a problem. The input routines are surprisingly good. One question, requiring as an answer the number 10, recognized "ten" as correct. It's nice when a programmer anticipates these things. *Metric System Tutor* is an excellent program.

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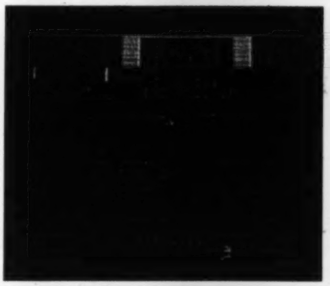

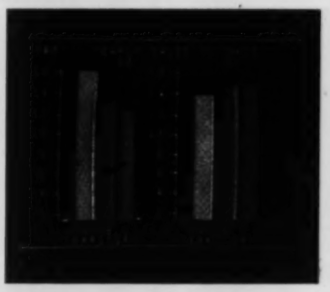

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We'll be happy to direct you to your local STC Coloring Board dealer. Just write or call Software Technology for Computers, P.O. Box 428, Belmont, Ma. 02178. (617) 923-4334.

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(Apple is a trademark of Apple Computer Company)

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OUR GUARANTEE — Buy both our software and that of our competitors (who will no doubt charge several times our price because they need to recapture their development cost). Compare the two systems and we know you'll return theirs (make sure they'll let you return their software). If you decide not to keep our system, then return it within 45 days for a full refund. Once you've used our system we're confident you'll be delighted.

†Microcomputers for Business, Applications, 1979

VISACCOUNT

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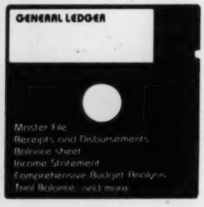
*The Apple version requires the Microsoft Z80 softcard.
CSCA has CBASIC2, CP/M and Microsfot Z80 softcard in stock.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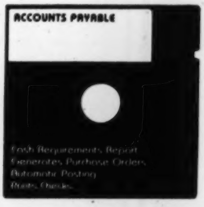
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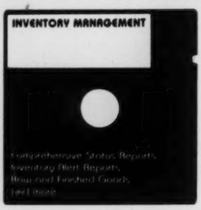
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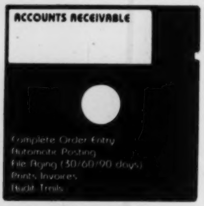
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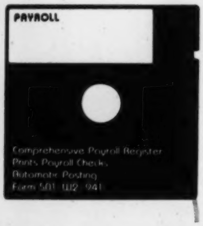
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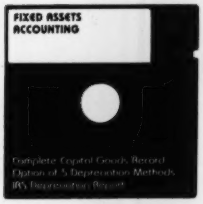
Comprehensive Payroll Register
Prints Payroll Checks
Automatic Posting
Form 501, W2, 941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CIRCLE 124 ON READER SERVICE CARD

Educational Software, continued...

By the Numbers

Educational Micro Systems, Inc. has a rather broad set of math programs for grades two through eight. The programs, on tape or disk for TRS-80 Models I and III, cover arithmetic, simple logic, and metric/English conversions. The basic appeal of the programs is their flexibility. Teachers can specify a variety of parameters for the programs. For instance, in addition, there are fourteen types of addends, including single random digits, four-digit multiples of ten, and four-digit numbers with zeroes in the hundreds place. The teacher specifies whether the student will receive assistance for each incorrect digit, or assistance only after the problem is answered. Also, the teacher has the option to allow a reward for correct answers. This reward is in the form of a rocket that crosses the screen. After the student answers correctly, he hits the space bar, sending a missile at the rocket. Finally, the program can run in either a practice mode, or in a test mode. The test mode, of course, doesn't include the reward or assistance options, but problems can be presented with a time limit.

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SOFTWARE PROFILE

Name: EMSI-6

Type: CAI Math

System: 16K TRS-80 (32K if on disk)

Format: Disk or Cassette

Language: Basic

Summary: Comprehensive math series.

Price: $199.95 for the entire set (individual programs also available)

Manufacturer:

Educational Micro Systems, Inc.
P.O. Box 471
Chester, NJ 07930

After the student has finished the specified number of problems a full report is given showing both the problems and the answers given, as well as marking those problems where help was requested or mistakes were made. The series also contains four programs that generate worksheets with math problems.

While the general concept of this package is good, it is unfortunate that the disk version is nothing but the cassette version transferred to a new medium. No record keeping has been added, thus missing one of the greatest potential advantages of the disk.

Backtalk

A classic program with a fair amount of educational potential has found its way into compiled Microsoft Basic for CP/M systems. *Eliza*, the interactive psychoanalyst is a program that converses with the user, providing a simulation of a non-directive therapist. This version, from the Artificial Intelligence Research Group, contains a few extra touches which existed in the original but were absent from previous Basic translations. Rather than just replying to the most recent statement, it will occasionally refer back to previous inputs. And, since the program is compiled, it runs fairly quickly. *Eliza* has potential use in various subjects. She could obviously be used in a course on psychology, but could also provide material for courses in communications, computer literacy, and other areas. It should be mentioned that *Eliza* has been available for several years on an 8" disk, along with 49 other games, as *Basic Games-3* from Creative Computing (Microsoft required), and that a listing of the program is included in the book *More Basic Computer Games*, also from Creative Computing.

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SOFTWARE PROFILE

Name: Eliza Version 3.0

Type: Interactive

System: CP/M System, Disk Drive

Format: Disk

Language: Compiled Microsoft Basic

Summary: Program includes features from the original Eliza.

Price: $25

Manufacturer:

Artificial Intelligence
Research Group
921 North La Jolla Ave.
Los Angeles, CA 90046

A Worthy Project

The majority of educational software is aimed at the elementary and high-school level, with most of the overflow hitting the colleges. One fine exception is a series of programs covering basic living skills for special learners. The programs cover important areas such as home safety and money management. Each program is very well done and includes all the trappings of good CAI. There are three levels of instruction, covering reading abilities from second to fifth grade, and the program branches to the appropriate level indicated by the user's response to questions. When the topic permits, the programs use graphics, adding to their appeal.

There are presently six programs available. *Job Readiness* gives a quiz to determine work attitudes and attempts to develop and reinforce positive work attitudes. From there, it goes on to cover job applications, interviews, and job-placement resources. *Home Safe Home* demonstrates potential hazards in the home, focusing on the identification and prevention of electrical, fall, and poison hazards. The other programs are *Income Meets Expenses*, *Money Management Assessment*, *You Can Bank on it*, and *Poison Proof Your Home*. Each program is supported by an extensive set of worksheets for the user. These programs represent a good start toward filling the needs of a frequently-neglected segment of the population.

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SOFTWARE PROFILE

Name: MCE (Microcomputer Educational Programs)

Type: CAI Basic Living Skills

System: 48K Apple, ROM Applesoft, Disk Drive

Format: Disk (from 4 to 8 diskettes are supplied per program)

Language: Basic

Summary: Fills a crucial need

Price: Ranges from $165 to $340

Manufacturer:

Interpretive Education
2306 Winters Drive
Kalamazoo, MI 49002

PET Drill

Addition - All Levels, and *Subtraction - All Levels* are two good drill and practice programs for the PET. The addition program has 24 skill levels, and subtraction has twelve, making the programs suitable for grades one through six. The teacher or student can also specify a time limit and other options. Correct solutions are greeted by a graphic creature that waddles onto the screen. The main appeal here is a versatile program at a low cost. As a further bonus, the programs will run on any flavor of PET, despite the abundance of incompatible ROMs out there.

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SOFTWARE PROFILE

Name: Addition—All Levels, Subtraction—All Levels

Type: CAI Math

System: 8K Pet

Format: Cassette

Language: Basic

Summary: Good drill and practice application.

Price: $20 each

Manufacturer:

Teaching Tools:
Microcomputer Services
P.O. Box 12679
Research Triangle Park, NC 27709

Prob-lem

The world is full of intriguing problems that never got into a textbook.

Problems for Computer Solution
by Stephen Rogowski.

Ninety intriguing and fascinating problems, each thoroughly discussed and referenced, make an excellent source of exercises in research and preliminary investigation. Eleven types of problems are provided in the following areas: arithmetic, algebra, geometry, trigonometry, number theory, probability, statistics, calculus and science. Author Stephen Rogowski of SUNY-Albany has included several problems which have never been solved. He feels that some research and an attempt to solve these will sharpen students' insight and awareness.

Some of the problems are not new like the one asking how much the $24 the Indians were paid for Manhattan would be worth today had it been deposited in a bank. However, this problem was revised to have a variable interest rate so it would be a challenge to program. Of course, many of the problems are new and have never been in print before.

The student edition has 106 pages and includes all 90 problems (with variations), 7 appendices and a complete bibliography. Cost is $4.95.

The 182-page teacher edition contains solutions to the problems, each with a complete listing in Basic, sample runs, and in-depth analyses explaining the algorithms and theory involved. Cost is $9.95.

To get one or both books send payment plus $2.00 shipping and handling per order to *Creative Computing*. Credit card orders may be called in toll-free to the number below.

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(In NJ 201-540-0445)

CIRCLE 350 ON READER SERVICE CARD

Educational Software, continued...

Published Works

Guidelines for Evaluating Computerized Instructional Materials, from the National Council of Teachers of Mathematics, 1906 Association Drive, Reston VA 22091, is well worth the modest price of $3.75. Prepared by William P. Heck, Jerry Johnson, and Robert J. Kansky, this 32-page booklet has a wealth of information for those who are involved with buying or evaluating educational software. This is highly recommended reading.

Personal Computers and Education: the Challenge to Schools, by James A. Levin and Yaakov Kareev, is an excellent overview of the subject. The 63-page report begins by covering the history of computers in education, then moves on to cover many facets of computers in schools. The material is clear, well written, informative, and fascinating. The report is number 98 of the CHIP (Center for Human Information Processing) series, and is available through the Library Loan Service of UCSD, San Diego, CA 92093.

JEM (Joint Educational Malagement) Research has produced some extremely thorough reference manuals that could be invaluable to anyone concerned with computers in schools. Volume I of *The Complete Reference Manual for the Instructional Use of Microcomputers* focuses on the Apple, and covers everything from setting up the system to evaluating and selecting courseware. The manual, with over 400 pages of information, is available for $30. Volume II ($25), is also slanted toward the Apple, and covers Basic, Pascal, and authoring languages. The final section contains in-depth information on the TRS-80, PET, Intecolor, Atari, and Apple, including good coverage of available printers and other peripherals. As if this hasn't kept JEM busy enough, they also publish *Micro-Scope*, a monthly newsletter produced on behalf of the Ministry of Education of British Columbia. A one-year subscription outside B.C. costs $12. For further information, contact JEM Research, Discovery Park, University of Victoria, P.O. Box 1700, Victoria, B.C., V8W 2Y2, Canada.

* * *

> *"An educated man stands, as it were, in the midst of a boundless arsenal and magazine, filled with all the weapons and engines which man's skill has been able to devise from the earliest time."*
>
> *Thomas Carlyle*

* * *

Other Media

Adventures of the Mind is a series of six 15-minute video tapes on personal computing. Designed to be used in the classroom, the package includes a 21-page teacher's guide and video tapes in 2" quad, VHS, Beta or 3/4" format.

Although we were not able to view the sample tape we received on our video tape player which is compatible only with Beta II and III formats, we were impressed with the program as outlined in the teacher's guide.

Topics covered include: Computers as Personal Tools; Computer Components and Functions; The Basic Language — A Beginner's Introduction; Data Processing, Control and Design; Advantages and Disadvantages of Personal Computers; and Impact of Personal Computers on the Individual.

The teacher's guide provides questions and activities to be used before and after the viewing of each tape, outlines objectives and concepts covered in each lesson, describes the program, and suggests projects and follow-up activities.

Adventures of the Mind was produced by Children's Television International and the Applied Physics Laboratory of Johns Hopkins University and was the recipient of a recent International Film and Television Festival of New York award.

For further information, contact Children's Television International, Inc., 3 Skyline Pl., Suite 1100, 5201 Leesburg Pike, Falls Church, VA 22041.

Updates

CourseWare Magazine, covered last March, is still going strong. The magazine contains educational programs, along with a cassette copy of the programs. Single issues are $12.95. A five-issue subscription is $50. The address is CourseWare Magazine, 4919 Millbrook #222, Fresno, CA 93726.

Also in March, Resource Software International was mentioned as a company publishing software in written form. They also provide programs on disk for the Apple and in Microsoft for CP/M systems. The sample they submitted contained a series of question-and-answer type programs covering math and language arts. The Apple version had evidence of the conversion syndrome: no special features of the Apple were used. Their address is RSI, 140 Sylvan Ave., Englewood Cliffs, NJ 07632.

Final Note

The programs covered here represent a tiny fragment of available CAI. If none of the above software suits your needs, don't be discouraged. There are thousands of programs on the market, and Creative Computing will cover new releases as soon as they become available. □

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AVALON HILL GAME COMPANY

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Datestones of Ryn (cass.)	$19.95	now	**$16.97**

PERSONAL SOFTWARE

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CIRCLE 144 ON READER SERVICE CARD

Classroom Management System

Russell Zausmer

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SOFTWARE PROFILE

Name: Classroom Management System—Mathematics B
Type: Math
System: 48K Apple II Plus or 48K Atari 800
Format: disk
Language: Applesoft Basic
Summary: Straight A's
Price: $595
Manufacturer:
Science Research Associates
155 N. Wacker Dr.
Chicago, IL 60638

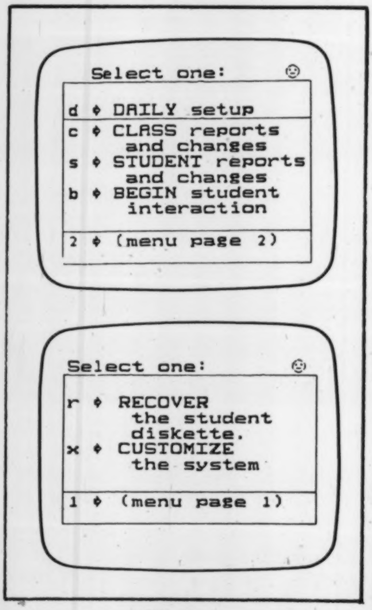
At the beginning of every school year, classroom teachers are faced with an awesome task: individualize instruction for the students in their classes. The average teacher has about 30 students in his classroom, so creating an Individualized Lesson Plan (I.L.P.) for each student in mathematics and reading is very time consuming. Every student must be tested, and each one placed in an appropriate group. A prescription must then be given to each student so that he may learn at his own pace. All this before the teacher has even begun to teach.

C.M.S. tests very specific skills defined by learning objectives.

While the educational concept is commendable, I.L.P. has placed a tremendous burden on the teacher. In many cases, teachers have become clerks and record keepers rather than instructors. Is there, then, any help for the classroom teacher who sees the value of individualized instruction?

Help is here! Science Research Associates (SRA) has produced a fine educational tool which harnesses the full power of the microcomputer. The courseware is called "Classroom Management System-Mathematics B." It is designed for students on a 4th through 8th grade level. The mathematics content includes: whole numbers—concepts; whole numbers—operations; fractions and mixed numerals—concepts; fractions and mixed numerals—operations; decimals—concepts; decimals—operations; ratio; proportion; percent; problem solving and estimation; geometry; measurement; and statistics and probability.

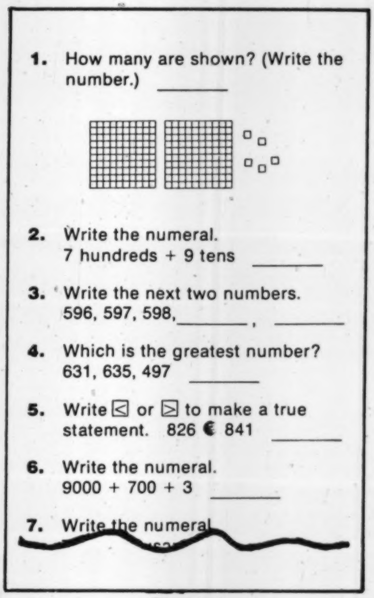
C.M.S. is a management system for classroom use that tests students, evaluates the tests, prescribes work to reinforce specific areas where the student is weak, and records both individual and class progress. C.M.S. can actually free the classroom teacher from the tasks associated with developing, administering and scoring tests. It will also free him from searching for appropriate remedial or enrichment materials, and from keeping records, while allowing him to individualize instruction for students who need extra help and for advanced students.



```
Select one:

d ♦ DAILY setup
c ♦ CLASS reports
      and changes
s ♦ STUDENT reports
      and changes
b ♦ BEGIN student
      interaction

2 ♦ (menu page 2)
```

```
Select one:

r ♦ RECOVER
      the student
      diskette.
x ♦ CUSTOMIZE
      the system

1 ♦ (menu page 1)
```

Figure 1.



1. How many are shown? (Write the number.) _______

2. Write the numeral.
7 hundreds + 9 tens _______

3. Write the next two numbers.
596, 597, 598, _______, _______

4. Which is the greatest number?
631, 635, 497 _______

5. Write < or > to make a true statement. 826 ○ 841 _______

6. Write the numeral.
9000 + 700 + 3 _______

7. Write the numeral

Figure 2.

C.M.S. tests very specific skills defined by learning objectives. It evaluates each student's mastery of the objectives and pinpoints weaknesses. This system immediately scores, evaluates, and records all test scores and then routes the student to the next test or prescribes remedial work geared exactly to the objectives he has failed to master. The prescriptions are correlated with six major basal math

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CIRCLE 170 ON READER SERVICE CARD

textbooks used in schools throughout the country and with many SRA supplementary programs. The teacher can select any or all of the references.

Customizing the Program

The first time the system is used the classroom teacher inputs or "customizes" the "Teacher Diskette." The teacher types in the class name, his own name, and a code word which allows only the teacher access to the recorded information.

The next step is to use the Student Diskette to record each individual student in the class (maximum of 40 students). Information such as name, age, I.D. number, and nickname are entered here. To enter a class of 40 students takes about half an hour, and is the most typing you will do! (See Figure 1.)

Once the teacher has entered the class information, he begins to enter information for the most useful part of C.M.S.: the Reference Diskettes. These diskettes allow the teacher to specify from which textbook he would like to take prescriptions (six major texts are already correlated with the program) and which SRA supplementary materials should be correlated. The instructor can also specify his own materials, special kits, games, other textbooks, or any other educational tool.

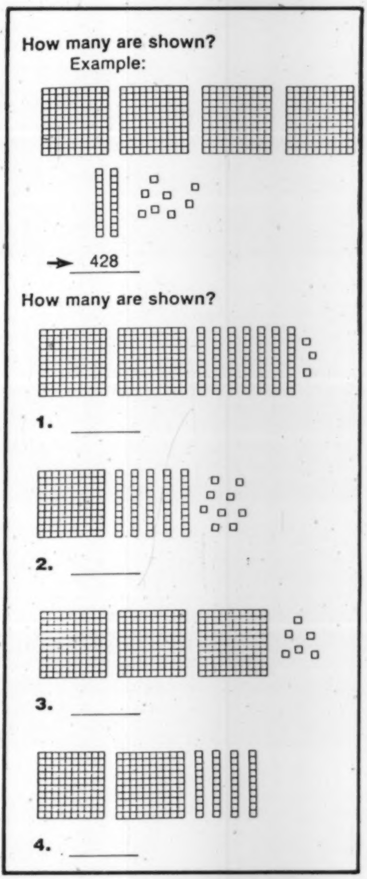
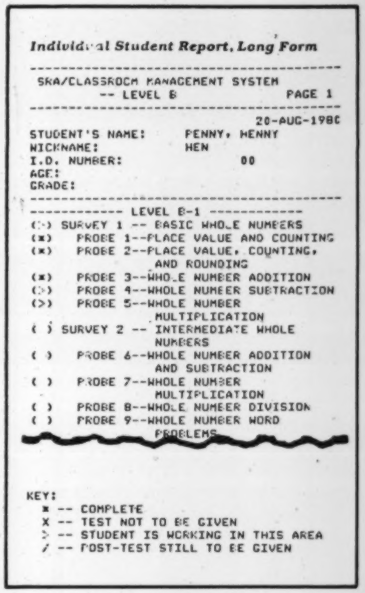


Figure 3.



Individual Student Report, Long Form

```
----------------------------------------
 SRA/CLASSROOM MANAGEMENT SYSTEM
        -- LEVEL B               PAGE 1
----------------------------------------
                             20-AUG-1980
STUDENT'S NAME:      PENNY, HENNY
NICKNAME:            HEN
I.D. NUMBER:                00
AGE:
GRADE:
----------------------------------------
------------ LEVEL B-1 ------------
(>) SURVEY 1 -- BASIC WHOLE NUMBERS
(*)    PROBE 1--PLACE VALUE AND COUNTING
(*)    PROBE 2--PLACE VALUE, COUNTING,
              AND ROUNDING
(*)    PROBE 3--WHOLE NUMBER ADDITION
(>)    PROBE 4--WHOLE NUMBER SUBTRACTION
(>)    PROBE 5--WHOLE NUMBER
              MULTIPLICATION
( ) SURVEY 2 -- INTERMEDIATE WHOLE
              NUMBERS
( )    PROBE 6--WHOLE NUMBER ADDITION
              AND SUBTRACTION
( )    PROBE 7--WHOLE NUMBER
              MULTIPLICATION
( )    PROBE 8--WHOLE NUMBER DIVISION
( )    PROBE 9--WHOLE NUMBER WORD
              PROBLEMS


KEY:
  * -- COMPLETE
  X -- TEST NOT TO BE GIVEN
  > -- STUDENT IS WORKING IN THIS AREA
  / -- POST-TEST STILL TO BE GIVEN
```

Figure 4.

There are four "open" spots in the program that allow this to be done easily by following the excellent instructions in the guide. Therefore, the teacher is not locked into using any specific textbook or material. If a new book comes in, he can add it to the correlations.

Now the system is customized for the class and the teacher can start the "student interaction" phase of the program.

The student's tests are in two parts, Surveys and Probes. In the teacher's guide all Survey and Probe tests are reproduced so that the instructor may make paper copies for the students. This saves computer time. The students can work the problems on paper and then enter them into the computer when their time is scheduled. The Surveys test broad areas of mathematical skills. The Probes pinpoint specific areas of weakness. Students are routed to the Probes through the Surveys.

Using the Program

Let's say that a student, Brian, is assigned to take Survey 1. (See Figure 2.) Brian inserts the student diskette and is asked to enter his name. If this matches a name stored on the diskette by the teacher, he can then enter his password. If this password also matches he will be routed to the Survey 1 diskette, which contains the first survey test. If Brian does not type in the correct information he will be asked to try again. He will have three chances to enter the information correctly, after which he will be told to "see your teacher."

When question 1, of Survey 1, appears on the screen, Brian types in his answer. A correct response will receive an "O.K."; a wrong answer a "NO." Then Brian will proceed to the next question. Some questions may be skipped, depending on how well he does; this is called the "abbreviation mode" and is used when a student is not doing well. It stops the student from becoming frustrated and saves time. After Brian is done, the computer routes him to the next survey test, if he missed no problems, or sends him on to the applicable probe test.

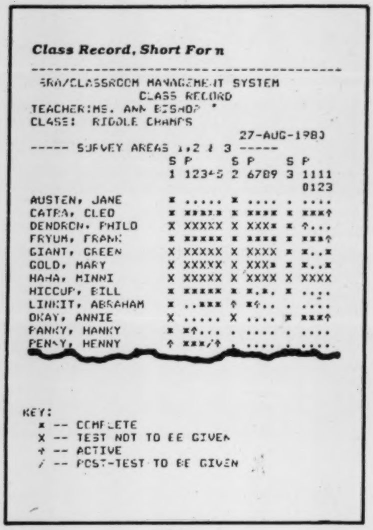
It should be noted that C.M.S. was not meant to teach. It is a management tool.

In this example Brian missed only one question—question 1. Therefore the computer has told him to go to Probe 1 where he will work on only those questions which relate to the missed question (See Figure 3). He will now be tested even further on his weakness.

If he should miss a question in a probe, a prescription will be given. He might be told to go to page 30 of one of the math texts or to do a certain teacher-made activity, or anything else that correlates with the area missed. The assigned prescription is recorded and should be given to the teacher. After the teacher feels that Brian has mastered the material, he will be sent back to the computer and tested only on that section of the probe that he missed.

If Brian fails in this second attempt a "double fault" mode is set up. Brian must bring his teacher back to the computer to type in a special code to allow him to continue with the probes or surveys. This insures that he must master any weak areas before he can continue with C.M.S.

As part of the customization of C.M.S. by the classroom teacher, he could choose to skip certain surveys or probes for the whole class or individually by student. Also the teacher may decide whether the student should be assigned a prescription as soon as a problem is missed or only when the test is completed.



Class Record, Short Form

```
---------------------------------------------
 SRA/CLASSROOM MANAGEMENT SYSTEM
              CLASS RECORD
TEACHER:MS. ANN BISHOP
CLASS:  RIDDLE CHAMPS
                               27-AUG-1980
----- SURVEY AREAS 1,2 & 3 -----
                   S P     S P    S P
                   1 12345 2 6789 3 1111
                                    0123
AUSTEN, JANE       * ..... * .... . ....
CATRA, CLEO        * ***** * **** * ***↑
DENDRON, PHILO     X XXXXX X XXX* * ↑...
FRYUM, FRANK       * ***** * **** * ***↑
GIANT, GREEN       X XXXXX X XXXX * *..*
GOLD, MARY         X XXXXX X XXX* * *..*
HAHA, MINNI        X XXXXX X XXXX X XXXX
HICCUP, BILL       * ***** * *.*. * ....
LINKIT, ABRAHAM    * ..*** ↑ *↑.. . ....
OKAY, ANNIE        X ..... X .... * ***↑
PANKY, HANKY       * *↑... . .... . ....
PENNY, HENNY       ↑ ***/↑ . .... . ....


KEY:
  * -- COMPLETE
  X -- TEST NOT TO BE GIVEN
  ↑ -- ACTIVE
  / -- POST-TEST TO BE GIVEN
```

Figure 5.

Now that our student, Brian, is done with his C.M.S. assignment, his teacher might like to review his records. The teacher can call up, via the screen or printer routine, the following choices for class reports: a) Class List—a simple list of all students in the class; b) Survey/Probe Status Report—a graphic list of each student and his status on all Survey/Probe areas; c) Individual Student Report—long form report with content areas and status (good report for consulations with parents); d) Class Record—lists all students in the class and shows their status on every Survey/Probe; e) Grouping Report—lists all students who are currently working on the same probes (perfect for "grouping" a class for small group instruction); f) Graphic Graph Grouping Report—shows a bar graph for all the probes and number of students working on each probe; g) Prescription Reports—these are the same reports the students get for their next assignment (See Figures 4, 5, and 6).

Evaluation

In actual use with a fourth grade class C.M.S. was very easy to use, and required no previous computer knowledge. The 170-page teacher's guide is quite thorough. You are led step-by-step through all phases of operation for both the program and the computer. There is even a section for teaching the students a little "computerese"; complete with computer riddles. The program takes advantage of the graphics capabilities of the Apple and Atari and the on-screen directions to the student are clear and easy to follow. A little smiling face lets a student know that he is operating the computer correctly and a frowning face signals him to try again. The program runs very smoothly and has never "crashed."

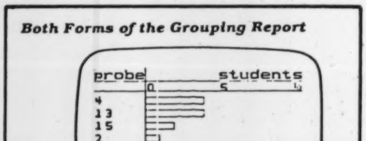
There are, however, a few problem areas. When a student misses a problem the correct answer is not given and there is no tutorial. However, it should be noted that C.M.S. was not meant to teach. It is a management tool.

A more serious problem has nothing to do with program content, but with the management of the program diskettes.

SRA has chosen to put the "management portion" of the courseware on a separate diskette. This program is set up for a one-disk-drive system. Not only does this necessitate the constant swapping of diskettes, but a more serious flaw quickly becomes apparent. SRA has envisioned one computer per classroom, and the system works fine in that environment. But most schools cannot afford to have one computer per classroom. Instead they have a computer room, with many computers being shared by all the classes in the school.

C.M.S. does not work very well under these conditions, because SRA has not provided a way to transfer student data and records from one diskette to another. Therefore, if you have one class sharing five computers, and you wish to have the entire class operate C.M.S. on a rotating basis, there is no way to transfer student data from the master student diskette to another student diskette. The teacher can make a duplicate student diskette—two are provided—but this merely makes a back-up disk.

SRA does sell a management package consisting of one teacher disk and two extra student diskettes for $250, but this does not solve the problem. It simply allows you to use the courseware with another class, keeping separate records. You still cannot "merge" the separate student data to compile one master class record. A data transfer routine should be provided by SRA.



Both Forms of the Grouping Report

```
Do you want to list
students who need to
take probe 4?
```

```
III- ----------------------------------
 SRA/CLASSROOM MANAGEMENT SYSTEM
        -- LEVEL B
---------------------------------------
        GROUPING REPORT
TEACHER:MS. ANN BISHOP
CLASS:  RIDDLE CHAMPS
                           27-AUG-1980
---------------------------------------
               PROBE 4
               4 STUDENTS
PENNY, HENNY
RIDDLE, CHICKEN
TANK, PUDDEN
WIG, PIGGY
---------------------------------------
               PROBE 13
               4 STUDENTS
CATRA, CLEO
FRYUM, FRANK
OKAY, ANNIE
PORGY, GEORGE
---------------------------------------
               PROBE 15
               2 STUDENTS
HAHA, MINNI
TUT TUT, KING
---------------------------------------
               PROBE 2
               1 STUDENT
PANKY, HANKY
---------------------------------------
```

Figure 6.

The use of this program in the classroom allows every child in the school to have true individualized instruction in mathematics, while allowing teachers time to do what they do best—teach.

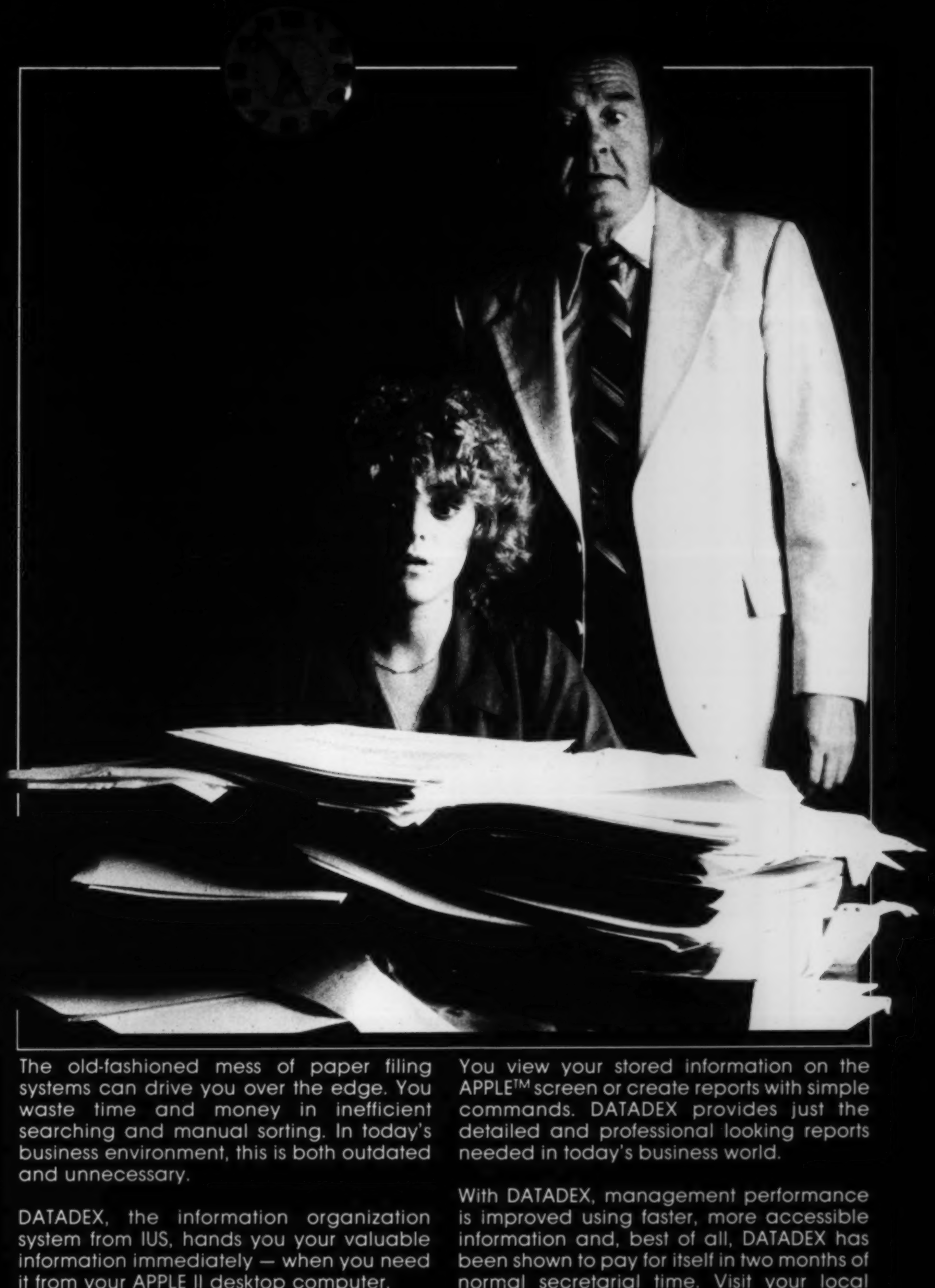
Another unfortunate feature of this courseware is that the school does not buy it; the school must pay a "license fee." A license arrangement usually provides better protection for the company than for the user. Also, since this program is copy-protected, its use is limited to 40 students per student diskette. I hope that SRA's license agreement will be modified to allow a reduction in price for an entire school which would like to use C.M.S.

Although most educational computer software is far from perfect, this package comes very close. It is one educational software set that deserves an unequivocal "A." SRA has spent much time developing this comprehensive program, and it shows. The use of this program in the classroom allows every child in the school to have true individualized instruction in mathematics, while allowing teachers time to do what they do best—teach.

I believe that what Visicalc has done for business software, "C.M.S.-Mathematics B" will do for educational software.

SRA's C.M.S.-Mathematics A" (grades 1-3) should be available in the fall. They are also developing a similar set to improve reading skills. ☐

The Evan's Report Is In There—Somewhere!



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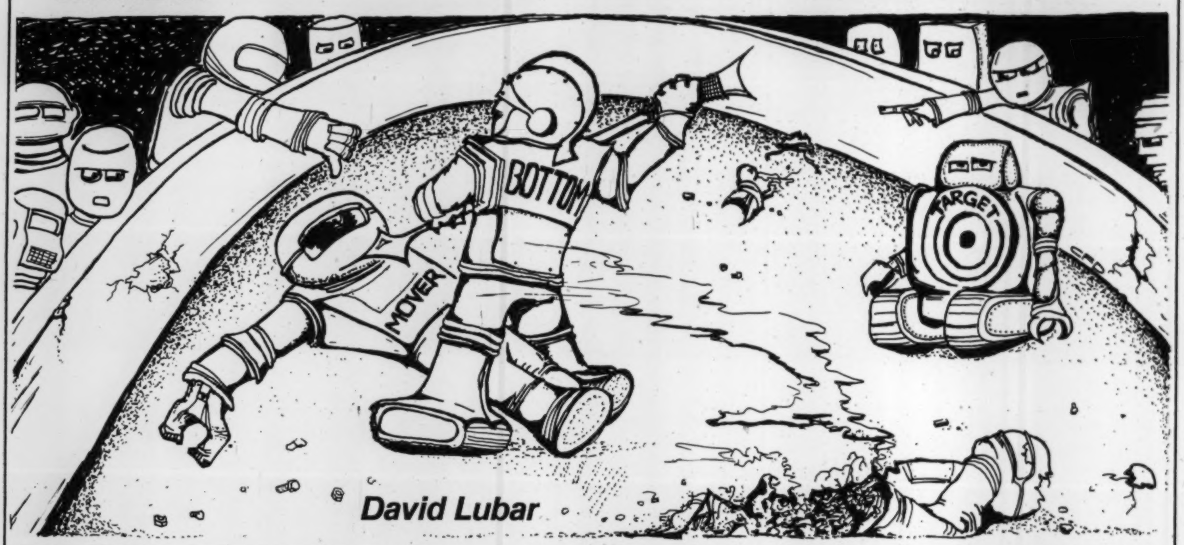
creative computing software evaluation

ROBOTWAR



David Lubar

creative computing

SOFTWARE PROFILE

Name: Robotwar
Type: Game
System: 48K Apple II, Applesoft, Disk Drive
Format: Disk
Language: Machine language
Summary: Complete game system for developing gladiator robots
Price: $39.95
Manufacturer: Muse Software
330 N. Charles St.
Baltimore, MD 21201

His name is Bottom. His battle plan has carried him through scores of contests in the arena. Bottom always seeks the south wall of the arena, hugs it and moves back and forth while aiming his radar to the north. But Bottom is blind to his flanks. During the battle, Mover slips down, locks on his target, and fires. Bottom keeps coming. Mover shoots again. They collide and both are damaged. But the shots have taken their toll. Bottom succumbs. Mover senses his damage and goes to a new location. He spots another target. But this one moves before Mover fires. The shell flies past the target. Mover scans clockwise with his radar. He finds the target again. This time he doesn't miss. He stands alone in the arena, the enemies are gone.

Bottom and Mover are two inhabitants of the universe of *Robotwar*. They have been programmed to find and destroy all who enter the arena. Were this all that occurred, Robotwar from Muse would be just another game. But there is more. Robotwar is a full system that allows the user to program and test his own robots. Among other things, this makes Robotwar an excellent educational tool.

Robot Talk

Bottom and his disk mates are programmed in a special robot assembly language. In essence, each robot acts as a small central processing unit. Actions are carried out by sending values to specific registers within the robot. For instance, the RADAR register activates the radar of the robot. A value from 0 to 355 can be placed in the register, causing the robot to send a beam at the appropriate angle. At this point the RADAR register will contain a new value indicating the result of the radar beam. The absolute value of this number tells the distance to the spotted object. The sign of the number tells the type of object. Walls return a positive value; other robots return a negative value. The robots also contain an AIM register which is used for pointing a gun, a SHOT register which fires a projectile, SPEEDX and SPEEDY registers to control movement, a DAMAGE register which indicates the percent of injury sustained, a RANDOM register for generating random numbers, and X and Y registers to indicate position. There are twenty-four storage registers and an INDEX register. The storage registers are for holding values. The index allows the programmer to address registers indirectly. Each register has a number. Thus, if SPEEDX is number seven, you can place a seven in the INDEX register and any access to INDEX will actually access SPEEDX. This is a powerful capability. For instance, by putting a base number plus a random value into INDEX, you can randomly access either SPEEDX or SPEEDY.

O.K., there is a set of registers. What can you do with them? Well, the robot language also contains a set of commands. A value can be sent to a register with the TO command. A TO B takes the value in A and places it in B. Arithmetic operations are allowed, such as A<5 TO SPEEDX. The flexibility of the robots is increased with GOTO and GOSUB, and their "intelligence" amplified with IF statements. Putting it all together, a simple scan and shoot routine would be:

```
LOOP
AIM+5 TO AIM
AIM TO RADAR
IF RADAR<0 THEN GOSUB SHOOT
GOTO LOOP
SHOOT
0-RADAR TO SHOT
ENDSUB
```

In this example, LOOP is a label. The next line increases the aim of the gun. If the radar reading is less than zero, a robot has been spotted. In this case, the SHOOT subroutine is called. Placing the distance of the robot (0-RADAR) into SHOT causes a shell to go in the direction of AIM and explode at the instructed distance. ENDSUB causes the program to return from the subroutine and continue execution at the line following the call.

The above, of course, is just one possible program segment. There are many ways to use radar, and many strategies. This is part of the value of Robotwar. Owners of the disk are enticed into creating better, more effective robots. If two robots employ the same strategy, the one using more efficient code will probably triumph. The user begins to ask questions such as "What if radar oscillated instead of sweeping?" or "How large an increment can be used without too much risk of scanning past a target?" These "what ifs" can be put to the test. In the arena, program flaws become painfully obvious, but there is a less painful way to test robots. The disk contains a test bench which executes the code and displays register contents. Radar spottings and damage can be simulated. In essence, the test bench provides full debugging features, including single step and trace.

> ***Even* Target, *whose strategy is to sit in place and do nothing, has been known to win once in a while.***

Let's step through some features of the disk. The menu begins with an option to put robots into the arena. If this is selected, the user sees a roster of available robots. From two to five can be selected. Once the choice is made, the battle begins. The robots appear as square, hexagonal, or octagonal shapes, each of which is distinctive. The side of the arena contains a display showing each shape, the name of the robot, percent of damage, and score. Every time a robot is destroyed, the survivors gain a point. Radar is shown by a white flash, the aim of the gun is indicated with a line inside the robot. Projectiles are small dots. Each robot in turn carries out an order. Since this is a sequential process, the program speeds up as robots are eliminated. With two robots, the action is quite fast.

Instead of a single battle, the user can schedule a tournament. Here, a running score is kept, allowing robots to be tested for long-term performance. It is possible for an inferior robot to win occasionally, but unlikely that such a robot will win a tournament. Even Target, whose strategy is to sit in place and do nothing, has been known to win once in a while.

The editor for writing robot code is a version of Supertext, and is easy to use. Since labels are allowed, the code doesn't require line numbers. The language is simple enough for beginners, but sophisticated enough to allow for a wide range of robots. Once the code is written, the source and object files can be saved to the master disk, or to a specially formatted backup. Disks can be initialized from the program, which is good since the master disk has limited free space. A robot on a backup disk must be transferred to the master before entering a tournament. This is an easy process which is fully explained in the documentation.

The manual contains full instructions for programming robots, including many examples of different routines, and clear descriptions of registers and robot language. The only weakness in the system is the use of several different units of measurement. The arena is 400 meters across. The X and Y locations of the robot are given as values from 0 to 255, while the speed of the robots is given in decimeters. Aside from this, *Robotwar* is both an excellent game and an excellent learning tool. ☐

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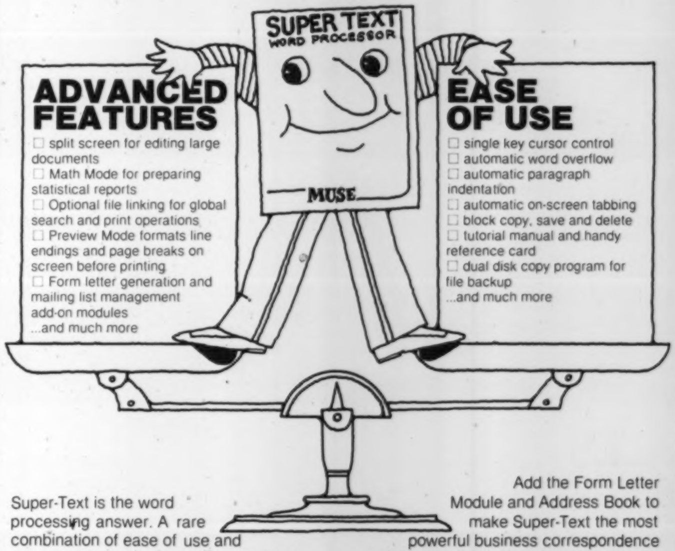

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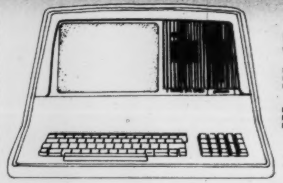

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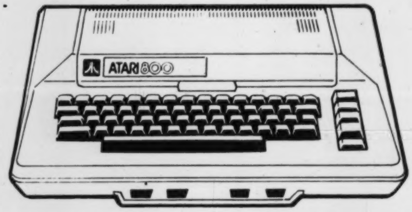

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CIRCLE 141 ON READER SERVICE CARD

Designing Good Educational Software

"We hope the educational programmers will agree to a set of standard input procedures."

James C. Kingman

We hear a great deal about the poor quality of educational software and quite a bit less about how to improve it. The author of this article provides some concrete suggestions. Although some of the specific things he suggests are for the TRS-80, they can be modified and the concepts applied to any computer.—EBS

"No, Jennifer. That's not right. Try again. Six plus three is how many?" I could feel my frustration rising. Worse, I could hear the frustration and anger in my voice as I spoke to my daughter.

Jennifer was nine years old and should have been capable of single integer addition long ago. But Jennifer is special—she is mildly retarded and goes to the elementary special education class at Ray Bjork School in Helena, MT.

Because of her retardation, Jennifer needs a large amount of overlearning in order to master a skill. A skill, such as single integer addition, might be mastered by a child of average intelligence in a couple of months while the same skill might take Jennifer and children like her a year, two years or more to master. It will take Jennifer many hours of drill and practice before she can master simple arithmetic.

Unfortunately, on that winter night as I was working with my daughter, the only thoughts on my mind were negative ones. They ranged from the "poor me" question of why couldn't Jennifer be normal to the realization of the enormous cost to taxpayers to educate special children. These thoughts plus the frustration of not being able to get Jennifer to understand and remember what, to me, were the simplest of concepts brought a premature end to our evening practice session. I ended it with some stupid remark like, "If you're not going to try, I'm not going to help you." Fortunately for special children everywhere, I am not a teacher.

About a week after the frustrating evening with my daughter, I was in the Radio Shack store to buy a new trinket while the salesman was demonstrating the TRS-80 to another customer. As an information management specialist, I was familiar with home computers since I had looked them over carefully out of professional curiosity when they first came on the market. However, as one who never balances his checkbook and dislikes bookkeeping, I really didn't see how I could use a computer at home. Oh, it would be fine to tinker with, but that hardly justified the cost.

Then, as I was leaving the store, I heard the salesman say something to the other customer that turned on the proverbial light bulb. "Another use for the home is education. The computer is very good at presenting repetitive problems in math and language."

"Of course!" I thought.

"Drill and practice," I muttered.

"Repetitive presentation of practice problems with infinite patience in an emotionally-neutral manner," I said aloud to the salesman and customer. Startled, they only stared at me.

I'll take one, please," I said to the salesman. He continued to stare at me.

"I would like a home computer. One of those. Today. Now, if you have one in stock."

"Slowly, still staring, he headed for the stockroom. When he returned with the large box containing my new computer, I already had my check made out.

"Do you know how to program in Basic?" he asked as he wrote out the receipt.

"No, but I will figure it out," I said, not bothering to tell him I knew several other computer languages.

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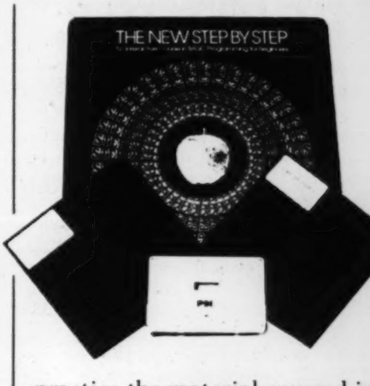

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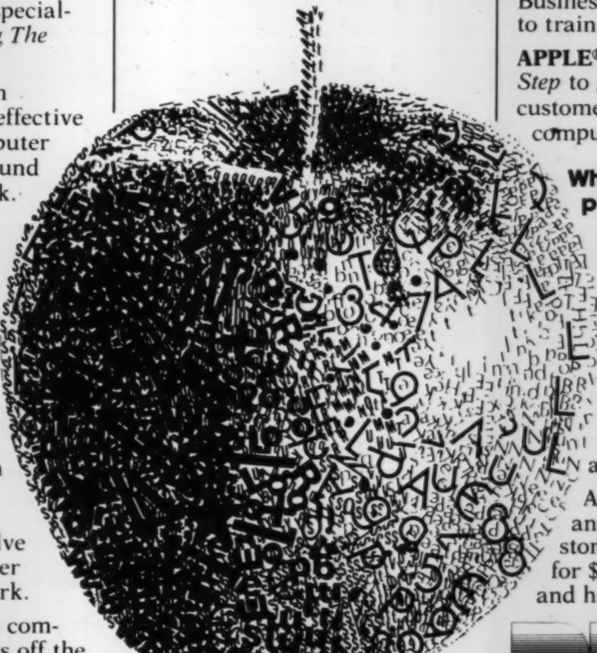

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CIRCLE 297 ON READER SERVICE CARD

Again, the stare of incredulity. To this day the salesman, whom I have come to know well, suspects that I'm not altogether sane.

That was two years ago. Since that time I have quit a well paying job and, with an educator and an experimental psychologist who specialize in human learning and motivation, formed a non-profit research and development corporation that specializes in microcomputer applications for developmentally and learning disabled individuals. I now spend most of my energies in the field of educational uses for microcomputers. This article is about what we have learned in the last two years. It is offered as a guide to others who want to write good Computer Assisted Instruction (CAI) and see it used in schools.

After acquiring a microcomputer for educational use one quickly discovers that there is not a great deal of software available. An added problem is that much of what software is avilable is not particularly good. We believe that good educational software must have eight characteristics. The eight characteristics are: 1) Educational Soundness, 2) Ease of Use, 3) "Bullet" Proofing, 4) Clear Instructions, 5) Appropriate Language, 6) Appropriate Frame Size, 7) Motivation and 8) Evaluation.

These eight characteristics are the same whether you are writing drill and practice programs for elementary age mentally retarded children or tutorial programs for graduate students in physics. Applying these eight characteristics will not guarantee a good educational program, but ignoring them will guarantee a poor one.

Educational Soundness

The first and most important characteristic of CAI courseware is that it be educationally sound. By educationally sound we mean that the material to be presented, (1) is relevant to the student's needs, (2) is appropriate for the learning objective, and (3) does, in fact, contribute to the learning process. To be relevant to the student's needs, the material must be tailored to the current curriculum of the class. For example, if a junior high social studies class is studying economics, a tutorial program presenting the concept of "marginal propensity to consume" may not be relevant to the student's current needs. On the other hand, a simulation program that lets the student play king by allocating the resources of a fictitious country between "guns and butter" and then presents the results of the student's allocation, may be very relevant to the student's need to understand simple economic relationships.

The courseware developer must also know what the learning objectives are, or define them himself. Stated a different way: what is it you want to teach? For example, if you want to teach a child the value of coins, a drill and practice program that displays a facsimile of a coin, then asks the student to identify its value may meet the learning objective much better than a simulation program that tries to get the child to make change for a hypothetical purchase.

The most difficult attribute of educational soundness to measure is whether, in fact, the program does contribute to the learning process. In two years, the only good technique we have found to determine this is field testing. The statistical techniques to measure this attribute are beyond the scope of this article, but the courseware developer should be aware of them in testing his programs.

Ease of Use

The second characteristic of good educational software is *ease of use*. Ease of use means that the program is designed to be loaded and executed by a user with minimum skills and knowledge. We believe that the best educational software assumes that the user has no knowledge of computers or programming, has no typing skill and will not read printed instructions, except as a last resort. Even then, if the instructions are read, they will not be understood. We recognize that this assumption is not true for most teachers, parents and students. However, if you develop your educational software assuming that it is true, you will probably go a long way in assuring that your programs are easy to use.

> ***A bullet is a 10-year old hyperactive child who will press every key on the keyboard at every opportunity.***

Bullet Proofing

Closely related to ease of use is bullet proofing. A bullet is a 10-year old hyperactive child who will press every key on the keyboard at every opportunity. Regardless of how well you think you have considered every contingency, the bullet is guaranteed to bring any new program to a premature halt within 30 seconds.

Some common bullet proofing techniques are:

1) Disabling the BREAK key at the beginning of the program.

2) Testing input responses for appro-

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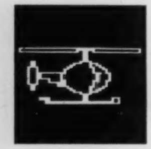

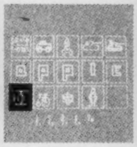

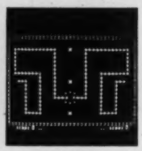

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priate range and type before they are accepted by the main routine of the program.

3) A null INKEY$ command before an operational INKEY$ to eliminate any response made prematurely by the student.

4) Error trapping routines that allow the program to recover if our bullet does find an unexpected way to terminate the program.

Depending on the audience your programs are aimed at, you may even wish to disconnect or physically move the RESET key. For example, the RESET key on the Radio Shack TRS-80, Model I, is inside the keyboard case and covered by a little door. This can be effectively taped shut to prevent unauthorized use of the RESET key. On the Radio Shack TRS-80 Model III the RESET key is on the keyboard. While it is recessed, even tape will not prevent inquisitive fingers from finding it. Thus, before the Model III is useful in an elementary special education class, we will need to move the key to the rear or the bottom of the cabinet.

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"Your program is excellent except for the playing of the Triumphal March from Aida for each correct answer."

Instructions

The fourth characteristic of good educational software is clear screen-oriented instructions on how to use the program. We believe all necessary instructions would be presented via the screen. These instructions must be clear and concise while giving the user sufficient information to feel comfortable in using the program. The three most common methods of presenting instructions are sequential, menu driven and the use of HELP. Sequential instructions generally present textual material in much the same fashion as printed instructions would for assembling a bicycle. Their advantage is ease of programming. The disadvantage is that they are somewhat overwhelming when presented single spaced on a video screen, and many times are not read. We recommend no more than one page of sequential instructions in any program.

The use of a menu can be very effective in allowing the user a choice of what he wants the program to do. A well designed menu can also provide much information about the operation of a program. For example, if you are writing the instructions for a drill and practice arithmetic program, you could write a page or more of sequential instructions that explained how the program worked and asked the student or teacher to enter the word "add," "subtract," "multiply," or "divide," to select which operation was to be practiced.

Alternatively, you could display a menu that said:

1) Addition
2) Subtraction
3) Multiplication
4) Division
Enter number of choice?

Those four numbers and eight words convey extensive information to the user about what the program may do. Multiple menus can then be used to define the desires and needs of the user further. For example, if the user inputs "1" in the above example another menu might be immediately displayed that said:

Do you want to begin practice with:
1) Single integers without carry
2) Single integers with carry
3) Multiple integers without carry
4) Multiple integers with carry
Enter number of choice?

Once that choice is made another menu might be displayed that allowed the user to choose the format of presentation. For example:

Which format?
1) 4
+4
——

2) 4 + 4 =

Enter number of choice?

This process can continue until all program parameters have been defined.

A third method of giving instructions is through the use of a HELP routine. Generally the course developer must create the software routine that will accommodate this method, but it can be a very powerful method of only providing instructions when they are needed. In our previous example the teacher may want an explanation of "single integers without carry." To get this explanation he would enter HELP 1. The screen would then display:

HELP 1.

Single integer addition without carry will generate random addition problems whose terms will be single integers from 0 to 9. The addition of these terms however, will never result in a sum greater than 9.

Press 'ENTER' to continue.

From the viewpoint of the user, the HELP routine is the most efficient since it presents only those instructions that are needed.

We believe that a combination of all three methods of instruction are useful in good educational programs. We prefer to use a brief overview of the program at the beginning then go to the menu-driven instructions to select program parameters. Should the user need further information about a particular menu item he can enter HELP and the number of the item. This would provide a detailed explanation of the menu item. One important rule in writing any type of user instructions, is to keep them clear, concise and simple.

Appropriate Language

The fifth characteristic of good educational programs is the use of appropriate language for the audience who will use the program. If you are writing programs for a senior high gifted and talented science class you may use language entirely different from that required for programs in a third grade arithmetic class. A classic violation of this principle is a number concepts program for kindergarten by a major manufacturer that displays:

Welcome to Kindergarten. Please wait a moment.

Presumably this was written to pacify the teacher while the computer is doing some internal housekeeping. It might have been better if the time was filled with some entertaining graphics or just a flashing

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picture to entertain non-reading kindergarten children while the housekeeping was performed. The key to appropriate language is knowing the general skill level of your targeted user.

Frame Size

The sixth characteristic is appropriate frame size. Frame size is defined as the amount of material which will be presented to the student in each segment of the program. To illustrate this, consider an arithmetic drill and practice program. If our program only practiced addition and subtraction we could design the algorithm with only two frames (i.e., addition and subtraction). Each term of each problem could be created with the statement TERM=RND(n). Thus, in addition to our two frames being defined by the type of operation, they are further defined by the value of n. If n = 100 then the first frame of our program would create addition problems with terms ranging in value from 0 to 100. The second frame would create subtraction problems with terms ranging in value from 0 to 100.

Now, these are valid frames from the standpoint that they will execute. They may not be good frames from an educational standpoint, however. For instance, there is no control over whether addition problems will generate a carry to the next place value or whether subtraction problems will require a borrow. Worse, the design allows generation of subtraction problems whose difference is a negative integer. To prevent this we must further define our subtraction frame to cause the minuend to always be larger than the subtrahend.

If our program is aimed at students with varying skill levels in arithmetic our frames still might not be very useful. We would want to subdivide the addition frame into a series of smaller and progressively more complex frames. One method might be that shown in Figure 1.

As you can see our frames can be defined as broadly or narrowly as necessary. The guideline for frame size is that the frame should be large enough to generate sufficiently diverse material that the student is challenged but not frustrated, and small enough to assure a high success ratio but not create bordom. Unfortunately, that is easier said than done. It may take a considerable amount of actual testing to determine optimum frame sizes.

Of course, all this can be avoided by just having one well-defined frame. The disadvantage then is that the program is so specialized that its usefulness is severely restricted. In general, the greater the

	ADDITION
Frame #	**Description**
1	Add two single integers whose sum will never be greater than 9 (no carry).
2	Add two single integers whose sum will be greater than 9 (carry).
3	Add one single integer and one double integer whose sum will not result in a carry.
4	Etc.

Figure 1.

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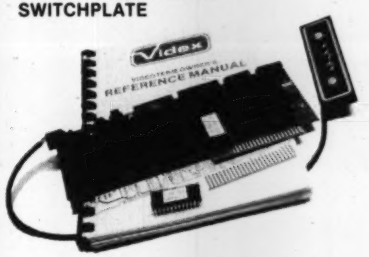

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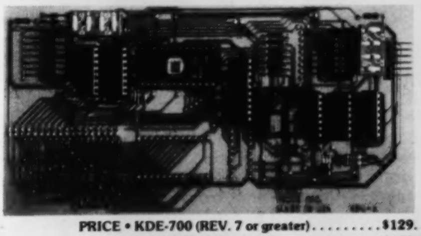

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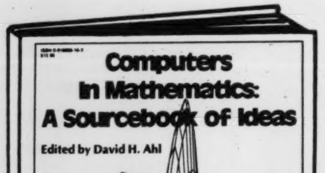

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number of frames, the larger the student population for which the program may be useful.

Another consideration in the construction of frames is the rules that the program will follow in moving the student forward or backward through the frames. For example, if we have a time telling program that displays the face of a clock and asks the student to determine the correct time, we might have five frames (i.e., whole hours, half hours, quarter hours, five-minute intervals and one-minute intervals). Assuming that our program begins with whole hours, we will need to determine how many problems with whole hours we will generate *and* how many the student must get right before we start generating problems with half hours. Once in the half hour frame we must determine how many problems the student can miss before the program moves back to the whole hour frame. As in determining frame size, the determination of frame movement often requires considerable testing to arrive at the optimum rules.

Motivation

Motivation is the seventh characteristic of good educational software. Unfortunately, it is probably more difficult to measure than any other characteristic. The goals of motivation are to keep the student interested in the lesson being presented and performing at his maximum capability. Educators have been trying to accomplish these goals for thousands of years with varying degrees of success. Like our predecessors we have failed in finding the magic answer to motivation. Like them, we have achieved varying degrees of success depending on the child and the technique used. When we discuss motivation as it relates to CAI we are only addressing the feedback to the student that is generated by the computer it self. For example, a CAI motivational feedback would be a "smiley" face displayed on the screen in response to a correct answer. It would not be the teacher providing verbal praise to the student for inputting a correct answer to the computer.

For research purposes we classify CAI motivational feedback into three broad categories. The first category is called "passive." An example of passive feedback would be simply telling the student whether he got the problem right or wrong. With non-readers it might be displaying a happy or sad face.

The second category of feedback is called "active." An example would be high speed graphics on the screen to reward a child visually for a correct response, or a Snoopy dog walking across the screen with a banner that says, "Great, John!"

The third category is called "interactive." An example of interactive feedback that we have found particularly effective with elementary aged learning disabled and mentally retarded students is rewarding them with a simple graphic computer game if they attend to the computer lesson and/or perform at a certain level of competence. This game allows the child to create his own computer art by pressing various keys on the keyboard. A variation of this is allowing junior high students to take 50 shots at flying saucers if they score 80% or better on a fractions and decimals program.

Evaluation

The final characteristic of a good educational drill and practice or simulation program is a student performance evaluation at the end. Tutorial programs may or may not require an evaluation of student performance.

A measurement of level of difficulty or complexity of the learning material presented should be given. The level of difficulty of the problems presented in drill and practice programs or the user-supplied or randomly selected variables that effect the difficulty of a simulation program are standard methods of measurement. To be useful, the level of difficulty must be easily understandable. For example, in the time telling drill and practice program, the level of difficulty might be expressed as the smallest unit of time at which the problems were presented (i.e., whole hours, half hours, etc.). In an arithmetic program the level of difficulty might be stated as "addition of two double integer terms whose summation does not result in a carry." While a statement in your documentation that "the program is designed for the second or third grader" or "the program can be used by preschoolers" may be good advertising copy, it is not particularly useful to a teacher or parent who is trying to determine how "Bullet" just did on his spelling practice.

The key to appropriate language is knowing the general skill level of your targeted user.

A measurement of the student's performance during the session should also be given. The number of problems presented and the number correctly answered in drill practice or a "point score" in a simulation program are two methods. Variations for drill and practice programs might be the number of seconds for a response (to measure on-task behavior); the average number of incorrect answers per problems presented (where a student is encouraged to guess at an answer); the number of problems on which a prompt was given (where the program presents a "prompt" or "help" when the student does not respond or responds incorrectly); or an actual listing of problems with incorrect responses (where the teacher wishes to modify the curriculum based on performance). For simulation programs, an analysis of where the student lost points might prove beneficial for measuring performance.

Depending on how complex you wish to make your educational program and the physical limitation of the hardware, you can add routines to record the historical performance of the student so the teacher or parent can see the changes in performance over a period of time. You might also want performance criteria to modify the curriculum presented. For example, the arithmetic program discussed under the section on appropriate frame size, might be designed to actually change the frame size based on student performance.

If the student performs above a certain level, the program might combine frames to allow the student to move ahead in problem difficulty more rapidly. On the other hand, if the student performs below a certain level, the design might split the frame size into smaller segments. If the current frame size is the subtraction of single integers from 0 to 9 without borrowing, the program might split the frame in two parts (i.e., integer 0 to 4 and 5 to 9) for the student who is having difficulty with the larger frame. The program could then drill integers 0 to 4 until mastery, and then move to integers 5 to 9.

As stated at the beginning, applying these eight characteristics will not guarantee a good educational program, but ignoring them will guarantee a poor one. Designing these items into your programs is not always easy. Sometimes it requires very sophisticated programming, but using these techniques will result in two things. First, they will make you a better programmer. Second, they will increase the quality of educational software available to schools and parents.

Jennifer still has trouble with arithmethic, but she is learning. Through a grant from the Developmental Disabilities Planning and Advisory Council of the State of Montana, she and her classmates have had a microcomputer in their classroom for the last year. They have drill and practice programs in arithmetic, reading readiness, spelling, time telling and verb tense. Our research has conclusively shown that elementary-aged, educable mentally retarded and learning disabled children can effectively use standard microcomputers as learning tools. Much more needs to be done, and, because of the tremendous potential, much more will be done. ☐

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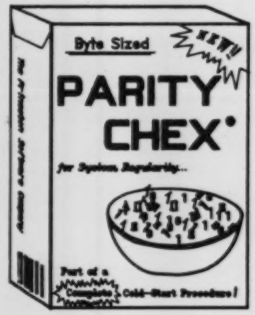
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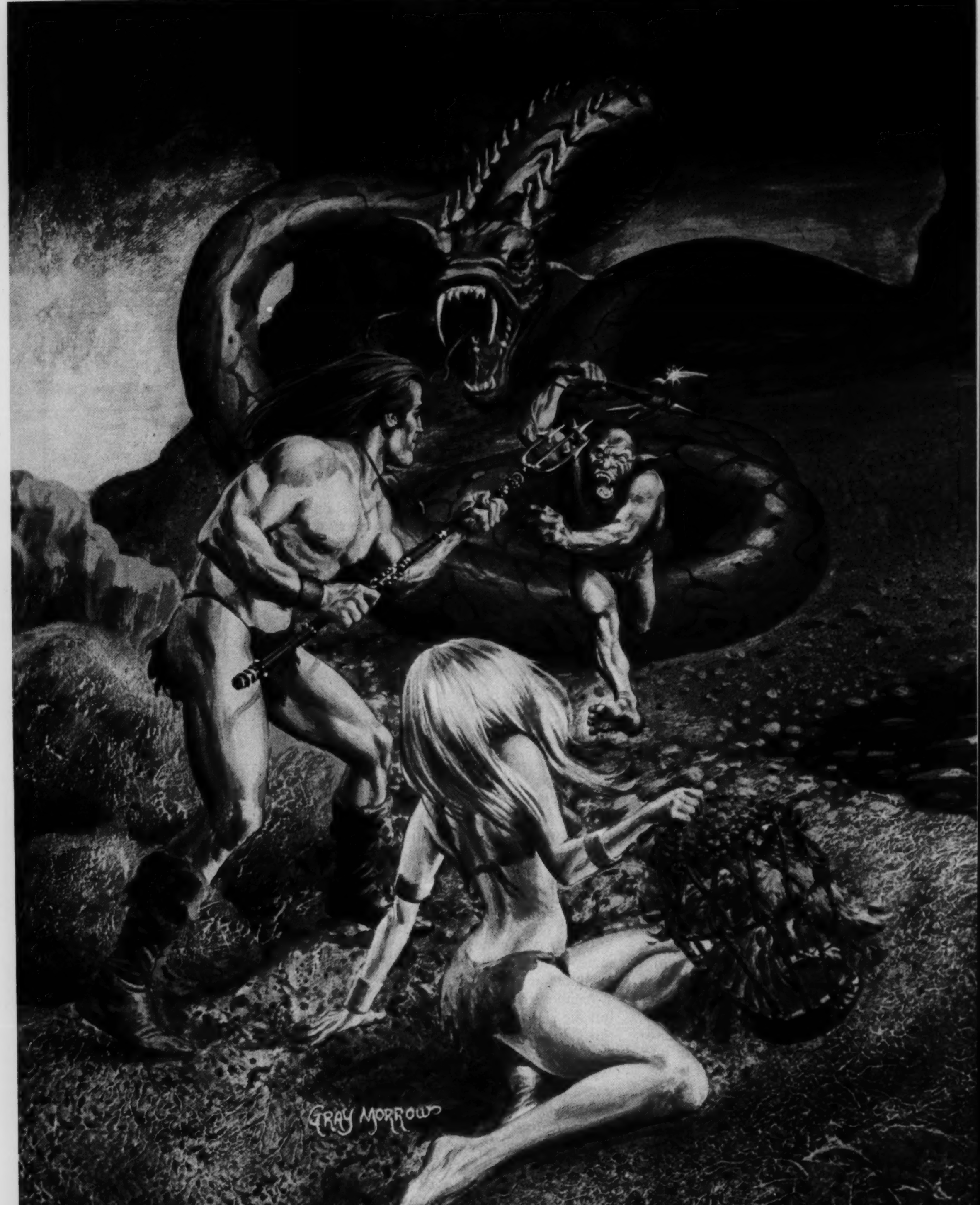

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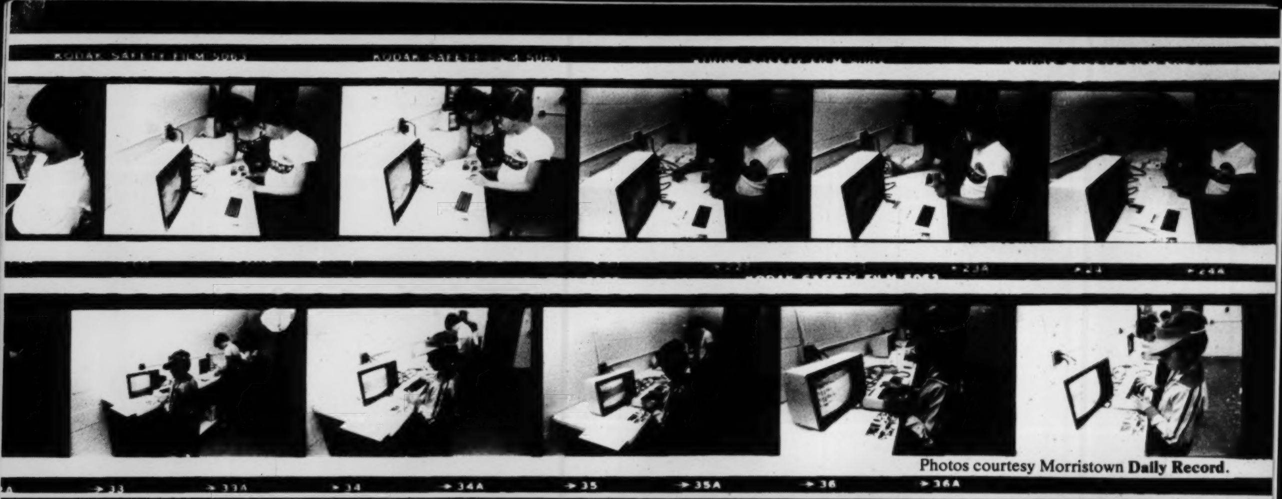

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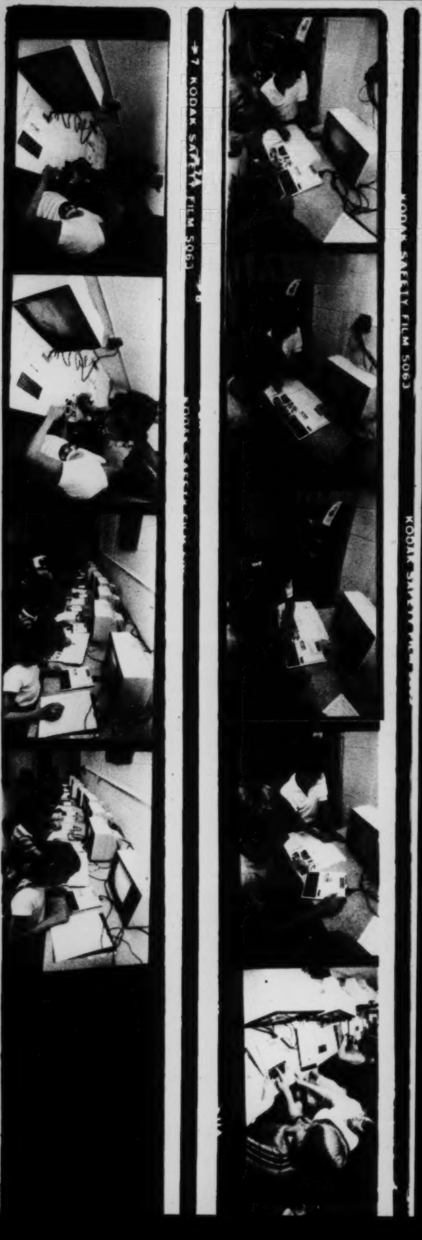

Glenn Kleiman   Mary M. Humphrey   Trudy Van Buskirk

EVALUATING EDUCATIONAL SOFTWARE

Educators are rapidly becoming aware of the potential of microcomputers. Currently available, relatively inexpensive, computer hardware is capable of providing powerful and flexible tools for teaching. Computers can be used to individualize instruction, maximize children's attention and present material in new ways through the use of graphics and simulations. Computers can be tutors that provide appropriate levels of instructions and questions for each individual. They can provide immediate feedback to students' answers, and they are infinitely patient. They can also keep detailed records of each student's performance.

Unfortunately, much of this potential remains unfulfilled. By itself, a computer is a dormant set of electronic components. No matter how potentially powerful, the usefulness of a computer is determined by the software available for it.

The development of educational software lags far behind the development of hardware. Many of the available programs are poorly designed, do not take advantage of the potential of computers, and are difficult for students and teachers to use. We fear that the use of poor software will discourage some educators from using computers at all.

Some good educational software is available, and much more should be available in the near future. Our aim in this article is to present guidelines for selecting good software. We will discuss the general principles that we, as educators, psychologists and computer specialists, believe should form a basis for both software development and software evaluation.

Since we will focus on general principles rather than specifics, what we have to say is relevant to a wide variety of teaching programs, topics, students, and computer systems. The guidelines are presented as questions one should ask about any computer software designed for educational use.

First we will discuss three very general questions. Then we will turn to more specific questions that are based upon the three general ones.

One general question is: *Does the software follow good educational practices?* Much of the available educational software seems to have been written by computer programmers who do not know much about education or the abilities of the children who might use the program. Such software may be of high quality from a programming point of view, but it often contains serious flaws from a pedagogical point of view.

Glenn Kleiman, Teaching Tools: Microcomputer Services, P.O. Box 12679, Research Triangle Park, NC 27709.

Mary M. Humphrey, and Trudy Van Buskirk, Ontario Institute for Studies in Education, Toronto, Ontario, Canada.

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For insight into some of the basic principles underlying **ISAAC NEWTON** see GODEL, ESCHER, BACH by Douglas R. Hofstadler, Chapter XIX and Martin Gardner's MATHEMATICAL GAMES column in **Scientific American,** October, 1977 and June, 1959. $24.95.

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For example, educationally well-designed programs present material in small, well-sequenced units. We have seen many programs that present too much material at one time, and present it in ways that may be confusing to many children.

Another good educational practice is to provide immediate feedback when the student makes a response. Computers can be programmed to do so, but many programs do not take advantage of this capability.

Other programs make poor use of the graphics capabilities of computers. A common fault is using graphics in ways that distract the child from the material to be learned.

Another general question is: *Is the software suitable for the intended purposes and users?* Some educational software does not present a reasonable progression of material to be learned and therefore will not fit into any curriculum.

Other computer programs are not acceptable because they are difficult for students and teachers to use. Many lack adequate instructions, do not take into account the reading level of the intended users, require complicated procedures to enter answers, or stop operating if the user makes an inappropriate response.

The remaining general question is: *Does the software take advantage of the capabilities of the computer?* The major reason for using computers as educational tools is that you can do things with computers that cannot be done, or are much more difficult to do, without them. However, computer programs often do not take advantage of the capabilities of the computer.

For example, we consider programs that are basically written pages moved onto the computer screen, in which the computer simply acts to turn the pages, to be a waste of computer resources. Some lessons are better presented with other media. Since most schools do not have an abundance of computers, the available computers should be used for those types of lessons for which they offer strong advantages.

We now turn to the more specific questions, each of which reflects one or more of these general concerns.

Does the Program Fulfill Its Purpose?

Computers can be used in teaching a wide variety of topics, and one must decide whether a given program fits into the curriculum being used. Once a match between the curriculum and a software package has been found, there are several other considerations regarding the role of the computer.

One must decide whether the computer will be used in the initial teaching of the material, for review or practice, for testing, for record keeping, for facilitating general skills, or for some combination of these functions.

Deciding which of these purposes one wants a given program to serve is an important step in evaluating the potential usefulness of the program.

Computers can be helpful in the initial teaching of material. For example, computer graphics and animation can provide useful visual aids. In some cases, computers can substitute for the teacher and textbook and actually teach the material.

Another possible role for the computer is to review lessons or present drill and practice. Since they are infinitely patient, computers can be especially useful for those students who need more repetition. Programs can be written to ask the student questions and give feedback when he answers.

Since computers can keep track of students' performance, they can also serve in testing and in record keeping. Well designed testing programs allow the teacher to enter questions and acceptable answers. Various criteria can then be set to individualize the test for each student. For example, programs can be designed to vary the difficulty of the questions presented depending on how many the student has answered correctly. With a printer, connected to the computer, written records can be produced automatically.

Does the program use sounds or graphics that might distract other children in the room?

In addition to helping children learn and master specific material, computers can be important in facilitating general skills. For example, many computer games provide good practice in eye-hand coordination, making rapid responses, and maintaining attention. Other computer games exercise general problem solving and creative skills.

Is the Software Appropriate for the Situation in Which It Will Be Used?

When evaluating software, one should keep in mind where and when it will be used. Will an adult be present to assist the student, or should the student be able to use the program without assistance? Will children work individually or in groups?

If they will work in groups, one should consider whether the program is designed so that children can share the work or alternate entering responses.

How often will each child use the program, and for how long? If a program is very repetitious, it might be suitable if it will be used only occasionally and briefly.

If a program is fairly complicated and will take a while to learn to use, it will be suitable only if sufficient computer time is available. Finally, will it be used in the classroom and, if so, does it use sounds or graphics that might distract other children in the room?

Is the Software Suitable for the Intended Users?

As we mentioned above, much of the available educational software seems to have been produced by computer programmers who know little about the children who might use the programs. One important area of concern is the instructions provided with the program.

Many educational programs do not provide adequate instructions. Often the instructions designed for the child are unsuitable because of the reading level required. For example, we have seen instructions requiring high school level reading in math programs designed for grade school children.

Many programs also fail to provide adequate intructions for the teacher on how best to use the program. In several programs, we have happened upon useful features that were never mentioned in the instructions.

Another important concern is how the user makes responses. There are many ways in which information can be entered into a computer. The most common ones use typewriter or calculator style keyboards. Young children can usually use these to enter single letter or digit answers. However, entering entire words or sets of words may be too difficult for young children.

Other input devices can be attached to computers. Light pens enable responses to be made by pointing at a particular part of the screen. Using a light pen, a child can answer multiple choice questions without needing to find the appropriate keys on the keyboard.

Other devices, such as joysticks and game paddles, also provide easy ways of making responses.

The pacing of the material being presented should also be considered. In some programs it is completely controlled by the computer. In other programs the material is presented in small units and the user presses a key to advance to the next unit. Since different children work at different rates, we generally prefer programs where the pacing is controlled by the user. The main exceptions are programs used to increase speed, such as

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in rapid word recognition. Even in these programs, there should be a range of speeds available so they can be used with a variety of children.

Does the Software Adapt the Computer to the User or Must the User Adapt to the Computer?

A very important consideration, often neglected by programmers, is whether the students and teachers will be able to use the program easily and comfortably. Psychologists call this area human factors—considering the people, not the machines.

Most addition programs provide examples of programmers' failure to adapt the computer to the user. When children do addition problems with paper and pencil, the addends are usually written one below the other, with the columns in line. The children work the problem from right to left, and mark carrying from one column at the top of the next.

Many addition programs present the problems with the addends side by side, require the answers to be entered from left to right, and do not provide any way of marking carrying. In using these programs, children often copy the problem, work it on paper, and then enter their answer into the computer.

Programs that present problems this way force the user to adapt to the computer. With more effort on the part of the programmer, the computer could have been adapted to the user.

Other examples of failing to adapt the computer to the user include using "*" instead of "x" to indicate multiplication, not providing any way in which mistakes can be erased, and filling the screen with so much information that it is difficult to read.

Another thing that makes programs difficult to use is lack of consistency. One should check whether the way information is entered is consistent within the program, and, if possible, is consistent with other programs the children might use. For example, on the PET computer a key marked DEL (for delete) is usually used to erase responses. A program that uses some other key, or does not allow erasing, or only allows erasing some of the time, may confuse children who are acccustomed to using the DEL key.

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"I'd get more work done if it would pause for commercials."

We hope that educational programmers will agree to a set of standard input procedures in the near future. As things stand now, educators should look for sets of programs that operate in similar ways.

Another problem good programmers should consider is that users do not always make the expected response. For example, given a choice of pressing "Y" for yes or "N" for no, an uncertain child might press "M" for maybe. Children often press keys just to see what will happen, and we have observed children pressing an "Erase" key to try to erase a difficult question. Good programs are prepared for inappropriate responses, so that these responses will either be ignored or result in a message such as "try again."

> ***Given a choice of pressing "Y" for yes or "N" for no, an uncertain child might press "M" for maybe.***

Poor programs are not child proof and may "crash" when inappropriate responses are made. When testing any program, one should make sure that inappropriate responses will not disrupt the program.

Does the Software Take Advantage of the Capabilities of the Computer in Presenting the Lessons?

Many lessons, creatively designed, can take good advantage of the graphics and sound capabilities of the computer. Any lesson where animation or interactive graphics can be useful is better presented on a computer than a book.

For example, many lessons in physics, such as those on wave forms or vectors, can benefit from animated representation of the phenomenon being studied.

Other examples include programs that produce maps and point to them during lessons, programs in which graphs are produced and revised to support the information presented, and programs which enable the user to, in some way, draw on the screen.

Other lessons, such as those in music, can take advantage of sound generation capabilities—the student can both see the note on the screen and hear it, different sequences can be played, and so on.

In addition to using the built-in capabilities, other devices can be interfaced to computers. Sound can be easily and inexpensively added to computers that do not have it built-in. Interfaces have been designed to enable computers to control tape recorders, slide projectors, and video recorders. We hope to see greater educational use of computers controlling these presentation devices.

Is the Program Adaptable to Different Children and Teaching Methods?

A good educational program can be easily adapted for different users. For example, a program that can only present 10 addition problems, with each problem having two addends and two digits per addend, is very poor. A program that allows you to specify the number of problems you want is a small bit better. A program that allows you to set different difficulty levels for the problems as well as the number of problems is much better. A program that also gives you the option of using subtraction, multiplication or division problems is better still. The lack of this type of flexibility is one of our most common criticisms of available programs.

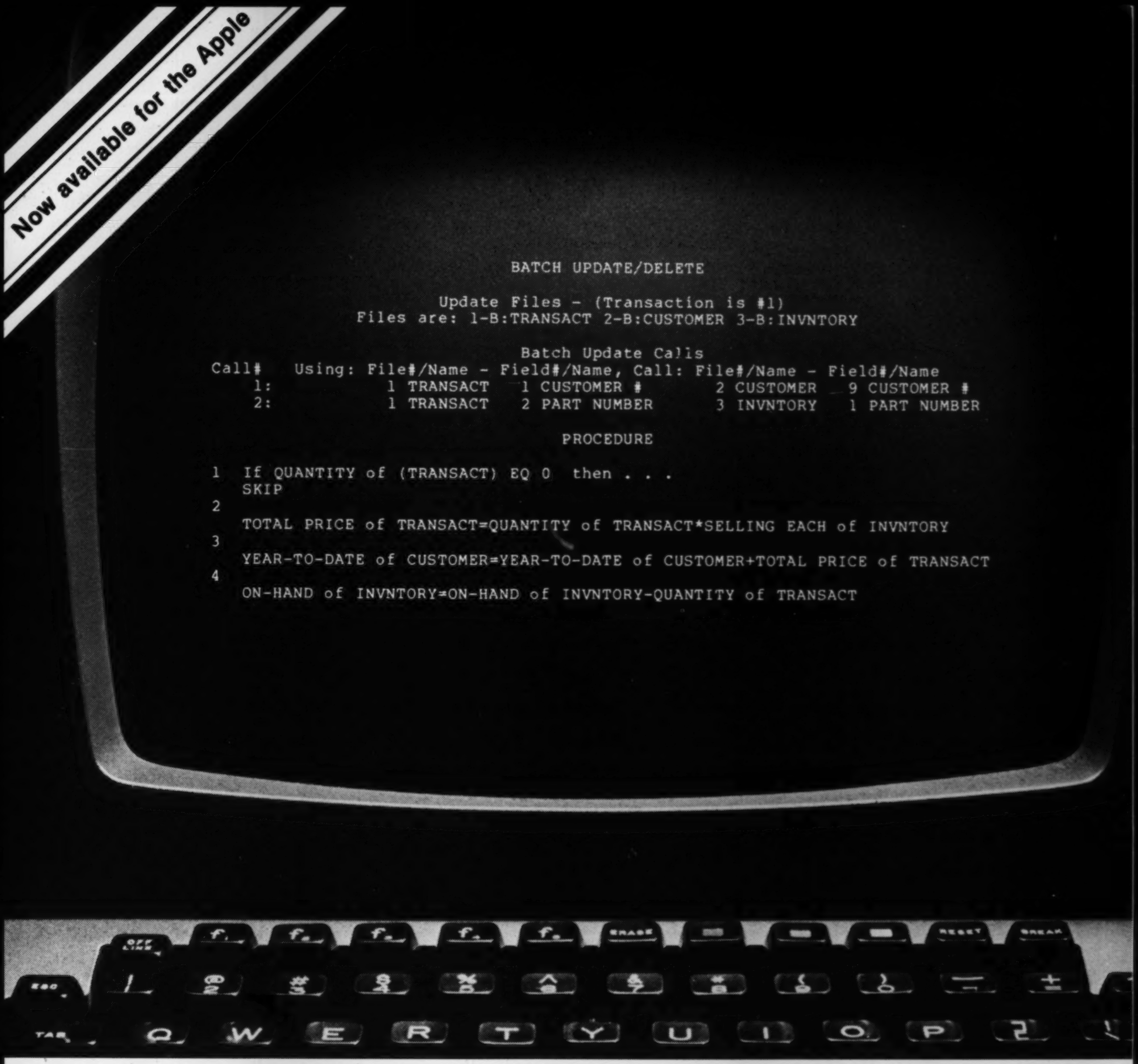
Some software companies market a large package of programs where one flexible program would serve the same purpose and be much less expensive.

For example, one company sells sets of 24 spelling programs. Each program contains a small number of words, and the only differences among the programs is in the word lists. It would not be difficult to write a similar program in which the teacher could input his own spelling words. This program could sell for a fraction of the price of the large package.

When obtaining flexible programs, one must be careful that they are easy to modify. Some provide a simple "menu," from which the user selects the desired options by pressing one or two keys. Menus are very easy to use. Other programs require the user to change the program itself, usually by modifying DATA statements or changing the values assigned to certain variables.

Will the Program Hold the User's Attention?

Another important question is whether the program will capture and hold the



```
                              BATCH UPDATE/DELETE

                       Update Files - (Transaction is #1)
               Files are: 1-B:TRANSACT 2-B:CUSTOMER 3-B:INVNTORY

                               Batch Update Calls
Call#   Using: File#/Name - Field#/Name, Call: File#/Name - Field#/Name
   1:            1 TRANSACT   1 CUSTOMER #        2 CUSTOMER   9 CUSTOMER #
   2:            1 TRANSACT   2 PART NUMBER       3 INVNTORY   1 PART NUMBER

                                   PROCEDURE

1   If QUANTITY of (TRANSACT) EQ 0  then . . .
    SKIP
2
    TOTAL PRICE of TRANSACT=QUANTITY of TRANSACT*SELLING EACH of INVNTORY
3
    YEAR-TO-DATE of CUSTOMER=YEAR-TO-DATE of CUSTOMER+TOTAL PRICE of TRANSACT
4
    ON-HAND of INVNTORY=ON-HAND of INVNTORY-QUANTITY of TRANSACT
```

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CIRCLE 167 ON READER SERVICE CARD

user's attention. Properly designed educational programs have been successful in keeping even the most distractible children engaged in a task for surprisingly long periods of time (see "Microcomputers and Hyperactive Children" by Kleiman, Humphrey and Lindsay in *Creative Computing*, March, 1981).

The graphics and sound capabilities of microcomputers, properly used, can hold children's attention. Improperly used graphics and sound can quickly become annoying and discourage use of the program. When examining these aspects of a program you should determine not just whether they are initially captivating, but whether they will remain so with repetition.

For example, a program that displays a rocket ship slowly rising on the screen, or plays a melody after each correct answer, might be initially motivating. However, after one has seen or heard this ten times it will probably become tiresome. We find that graphic and sound reinforcement which is used repeatedly should be rapid (i.e., two to three seconds) and varied. Different pictures or tunes hold attention much better than the same one or two repeated frequently.

The pacing of the program and the frequency of user responses also affect how well it holds children's attention. A program in which the child has to wait long periods, or which moves more quickly than the child can read or give answers, will not hold the child's attention. Likewise, the more frequently the child must make a response, rather than simply watch the screen, the more likely he will stay engaged in the program. Receiving immediate feedback to their responses also helps hold children's attention.

In many cases, educational material can be presented in a game format. We do not believe that all educational programs need to be forced into games. However, the competitive nature of games often does hold children's attention. The competition can either be against one's own prior performance, against the computer, or against another person.

Game programs should be checked to make sure the children will be able to play reasonably well, but still find the game challenging. A game which is too simple or too difficult will not keep one's interest. The best game programs allow the user to set the level of play—e.g., present the older or more capable users with more difficult questions or less time to perform the task.

A good computer program—particularly one designed for use by children with concentration problems—can monitor the child's responses and provide special messages. For example, the program can measure the time between the user's responses, and flash a special message or sound a buzzer if there is no response for a long time. We have not found many programs that do this, but we have found it useful in our research.

Does the Software Provide Useful Feedback to the User?

One of the major advantages of computer-based learning over other media is the capability of immediate feedback. As we mentioned above, immediate and frequent feedback helps keep childrens' attention on the task at hand, and this is especially important for children with attention problems. The right feedback at the right time is also important for facilitating learning.

Besides the motivating reinforcers for correct responses, an important aspect of a program is how it responds to incorrect responses. One poor but common type of response is simply to tell the child that he is wrong, and go on to the next part of the program. Some programs, written without any thought about who might use them, even display insulting messages after a wrong response. Messages from a computer such as "Wrong, Dummy" may be humorous to some adults, but can upset young children.

Messages from a computer such as "Wrong, Dummy" may be humorous to some adults, but can upset young children.

One good practice is to provide the child with a second chance when an incorrect response is made. For some purposes, this is best combined with a prompt of some sort. For example, a spelling program might tell the child which letters are incorrect, and then have him try to spell the word again. In programs where the questions are based on an immediately preceeding lesson, the appropriate section of the lesson might be repeated when the child does not answer a question correctly.

Another alternative is to give the child the correct answer. Depending on the content of the lesson, this may be best after a single incorrect response, or it may be better to give the child several tries before giving the correct response. In either case, a good practice is to provide some way for the child to compare his answer with the correct one, or to spend some time studying the correct one.

For example, in spelling programs the child should have to type the word correctly after being shown the correct spelling. Another good practice is for the program to store a record of the questions or problems the child answered incorrectly. These can be repeated later on, or given to the child at the end of the lesson for further study.

We have seen programs where the most interesting graphics and sound displays occurred in response to incorrect answers. These programs should be avoided, as they encourage children to make incorrect responses just to see what happens.

Other programs are designed to accept only the correct response. For example, some math programs will not let any but the correct number appear on the screen—if the child presses an incorrect number nothing happens. Faced with this type of program, some children just press all possible keys until they happen to hit the correct one, without paying any attention to the math problem. Clearly, this is not a recommended practice.

Conclusions

We have discussed several questions to be asked when evaluating educational software. All of them reflect three general requirements for quality educational software: 1) It must follow good educational practices; 2) It must be suitable for the intended purposes and users; and 3) It must take advantage of the unique capabilities of computers. Within these three general guidelines, which of the specific questions is most important depends upon the material being taught, the teaching method, the students' abilities, the available computer hardware, and other factors specific to each situation.

We hope this article will help teachers, educational administrators, and parents choose the best available educational software. We also hope it will encourage and facilitate the writing of good educational programs. □

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EXPLAINING COMPUTER RELATED CONCEPTS & TERMINOLOGY

Harold W. Lawson, Jr.

Have you ever tried to explain computer systems to someone who knows nothing or very little about them? Where do you start? Do you first explain the binary number system, Boolean algebra and/or computer logic? Perhaps you begin by showing the classic CPU, memory, I/O block diagram and explain each of these constituents, including stored programs, instruction sets, etc. Maybe you skip all of these low level details and explain flowcharting and/or some relatively simple high level programming language such as Basic.

Regardless of where you begin, you soon recognize that although you may be somewhat successful (after sufficient effort), the person being taught has no idea about computer systems and computing as a whole and many questions remain about the "miracle of the computer." On the other hand, it seems, on the surface, to be difficult to give a complete picture of computer systems right from the beginning.

After several years of experience with a "process oriented" approach we can remove the doubt and say that it is indeed possible (and desirable) to introduce computer systems concepts and terminology right from the beginning in an integrated manner. This approach has resulted in the book *Understanding Computer Systems** and the purpose of this article is to present the basic concepts used in this approach. As with all endeavours of this nature, the success depends upon proper structuring of the presentation. The approach used is highly pictorial, and terminology is introduced bit-by-bit in a logical fashion. Each chapter finishes with a summary, work list and problems. The entire vocabulary introduced is presented at the end in the form of a glossary.

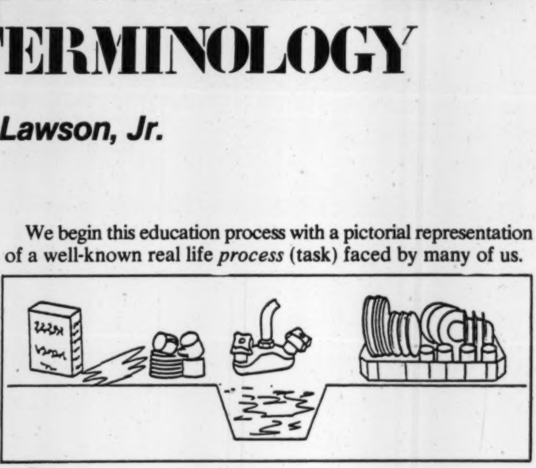
But enough about the structure of the book—let us consider the approach.

Introducing Processes and Systems

"People learn best when new concepts are presented in terms of what they already know."

The process is used as the LCD (lowest common denominator) for explaining the constituents of computer systems. At the beginning, it is necessary to select widely known model processes that can be used as the basis for association with computer system related processes. To show the example used, we take, as a verbatim quotation from the book, the introductory model process descriptions.

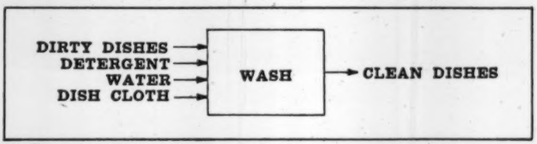
We begin this education process with a pictorial representation of a well-known real life *process* (task) faced by many of us.



A Process.

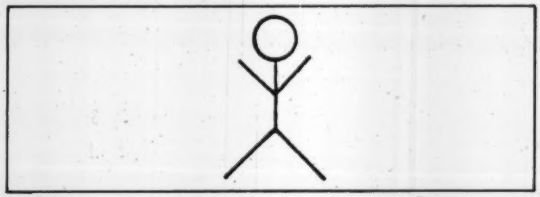
Note that the concept of *process* and *task* are synonymous and thus in all further references to process related concepts, the word "task" may also be used.

Let us now consider this real life process of washing the dishes in the form of an abstraction which shows the major elements of this process as follows:



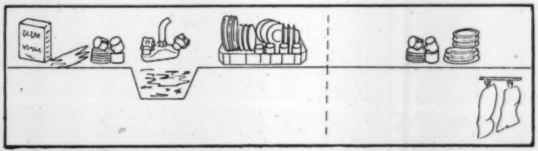
A Process Abstraction.

Dirty dishes, detergent, water and dish cloth are *process inputs* and clean dishes are a *process output*. The process which we have shown here can only be carried out, *executed*, when we apply a *processor*.



A Processor.

Let us complement this single process by introducing a second process, thus creating a *system* of *cooperating processes*.

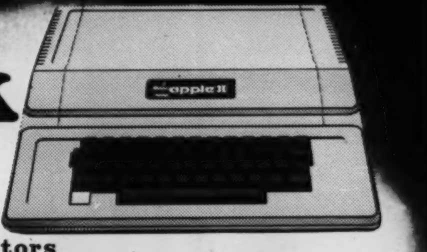


A Second Process

**Understanding Computer Systems*, by Harold W. Lawson, Jr., Lawson Publishing Company, Linkoping, Sweden, ISBN 91-7372-333-9. Similar versions of this paper have been previously published in *Computer Age*, issue 13, 1980 under the title "Understanding Computer Systems" and in *Mikrodatorn*, Nr. 2, 1981 under the title "Att Forklara Begrepp Inom Datatekniken." Permission of these publishers has been granted for publication in *Creative Computing*.

Harold W. Lawson, Jr., Linkoping University, S-581 83 Linkoping, Sweden.

Let us bring you an apple...



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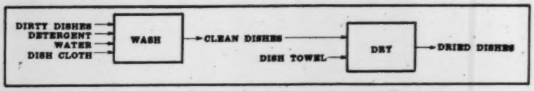
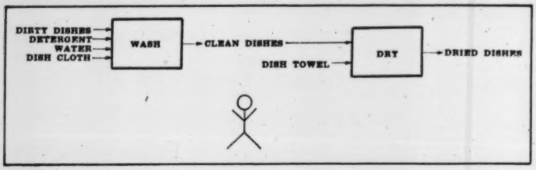
Note: Implicit in this description is the definition of a *system* as a collection of interrelated processes.

We can continue the general abstraction of this system of cooperating processes by introducing an abstraction for the second process, namely the drying process, in the following manner:


DIRTY DISHES
DETERGENT
WATER
DISH CLOTH
WASH
CLEAN DISHES
DISH TOWEL
DRY
DRIED DISHES

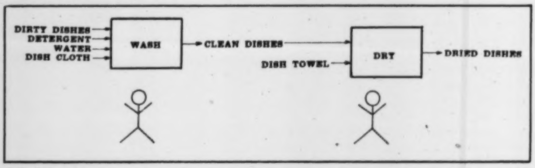
An Abstraction of a System of Cooperating Processes

If the processes are to be carried out by a single processor, *uni-processor*, then this single processor must be assigned to both the WASH and the DRY process as indicated in the following picture.


DIRTY DISHES
DETERGENT
WATER
DISH CLOTH
WASH
CLEAN DISHES
DISH TOWEL
DRY
DRIED DISHES

A Uni-processor

Note that if the dishrack becomes full during WASH execution, then the single uni-processor must be alternated between the execution of the processes WASH and DRY. Alternatively, we could assign a processor to each process, that is, the processes are executed *concurrently* (at the same time) by *multi-processors.*

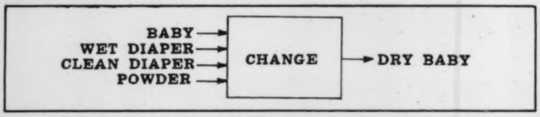

DIRTY DISHES
DETERGENT
WATER
DISH CLOTH
WASH
CLEAN DISHES
DISH TOWEL
DRY
DRIED DISHES

Multi-processors

During execution of a process by a processor, let us say the WASH process, the processor could be *interrupted* by a *high priority process* such as the following:

A High Priority Process

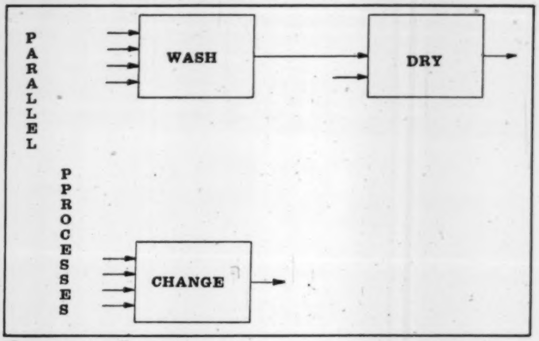
Consequently, a new process is *created* which we can represent abstractly as follows:


BABY
WET DIAPER
CLEAN DIAPER
POWDER
CHANGE
DRY BABY

An Abstraction of the New Process

In the case of a single uni-processor, the processor temporarily *suspends* the process it is currently executing and *initiates* execution of the CHANGE process. After *termination* of the CHANGE process, the processor returns to, *resumes*, execution of the process that was suspended.

Alternatively, in the case of multi-processors, the processor that acknowledges the interrupt (let us say the processor serving the WASH process) could *assign* another processor (the processor assigned to DRY or another available processor) to execute the CHANGE process *parallel* with the ongoing WASH and/or DRY processes as follows:

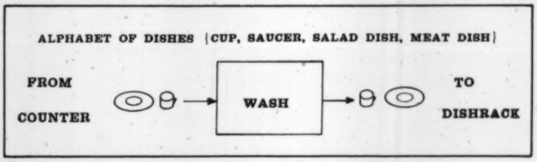

PARALLEL
PPROCESSES
WASH
DRY
CHANGE

Cooperating Process

At this point, we have introduced several important computer related concepts in terms that all can understand. The flavor of this example should now be remembered as we browse through, in a highlight fashion, the further presentation of concepts and terminology. While the remaining descriptions of the approach will be terse, you can certainly use your imagination to guess how the details of the approach are presented in the book.

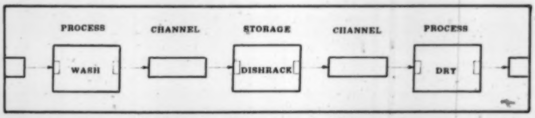
Data Flow and Control

Having introduced the basic process and system concepts, it is easy to build on the example to include data and control aspects. Data can be made analogous to *objects* processed by the processes of our example leading to the following view where the alphabet of objects is concretely *declared.*


ALPHABET OF DISHES (CUP, SAUCER, SALAD DISH, MEAT DISH)
FROM
COUNTER
WASH
TO
DISHRACK

Enumeration of Process Related Objects (Data)

The flow of objects within a process is explained in terms of classical data processing steps; namely, *input* (take object from counter), *process* (wash object) and *output* (place object in dishrack). The transmission of objects between processes (over channels), including "storage processes" is indicated by the following, from which, for example, the explanations of terms such as simplex, half-duplex and full duplex are easily developed.


PROCESS
CHANNEL
STORAGE
CHANNEL
PROCESS
WASH
DISHRACK
DRY

Transmission of Objects (Data) Over Channels

80 COLUMN GRAPHICS

commodore
CBM
computer

The Integrated Visible Memory for the PET has now been redesigned for the new 12" screen 80 column and forthcoming 40 column PET computers from Commodore. Like earlier MTU units, the new K-1008-43 package mounts inside the PET case for total protection. To make the power and flexibility of the 320 by 200 bit mapped pixel graphics display easily accessible, we have designed the Keyword Graphic Program. This adds 45 graphics commands to Commodore BASIC. If you have been waiting for easy to use, high resolution graphics for your PET, isn't it time you called MTU?

The image on the screen was created by the program below.

```
 10 VISMEM: CLEAR
 20 P=160: Q=100
 30 XP=144: XR=1.5*3.1415927
 40 YP=56: YR=1: ZP=64
 50 XF=XR/XP: YF=YP/YR: ZF=XR/ZP
 60 FOR ZI=-Q TO Q-1
 70 IF ZI<-ZP OR ZI>ZP GOTO 150
 80 ZT=ZI*XP/ZP: ZZ=ZI
 90 XL=INT(.5+SQR(XP*XP-ZT*ZT))
100 FOR XI=-XL TO XL
110 XT=SQR(XI*XI+ZT*ZT)*XF: XX=XI
120 YY=(SIN(XT)+.4*SIN(3*XT))*YF
130 GOSUB 170
140 NEXT XI
150 NEXT ZI
160 STOP
170 X1=XX+ZZ+P
180 Y1=YY-ZZ+Q
190 GMODE 1: MOVE X1,Y1: WRPIX
200 IF Y1=0 GOTO 220
210 GMODE 2: LINE X1,Y1-1,X1,0
220 RETURN
```

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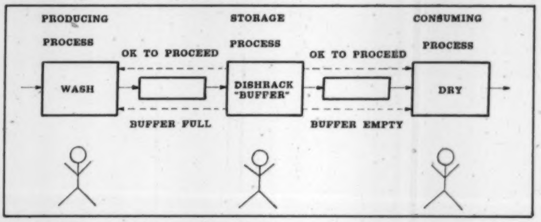
Concepts and Terminology, continued...

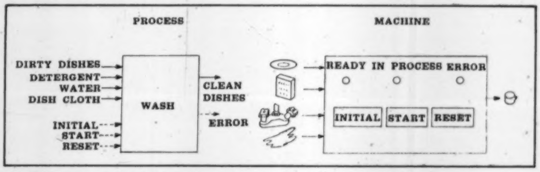
In explaining control, we consider *signals* to processes and related control mechanisms. For example, the following illustrates the producer-consumer relationship of asynchronous control where the dishrack provides a perfect example of a buffer. The concept of synchronous control is then explained and compared to asynchronous control.



PRODUCING PROCESS
STORAGE PROCESS
CONSUMING PROCESS
OK TO PROCEED
OK TO PROCEED
WASH
DISHRACK "BUFFER"
DRY
BUFFER FULL
BUFFER EMPTY

Asynchronous Control of Multi-processors

In finalizing the control notions, an important analogy is made by presenting the process as a machine with lights (corresponding to states) and pushbuttons as illustrated in the following illustration:

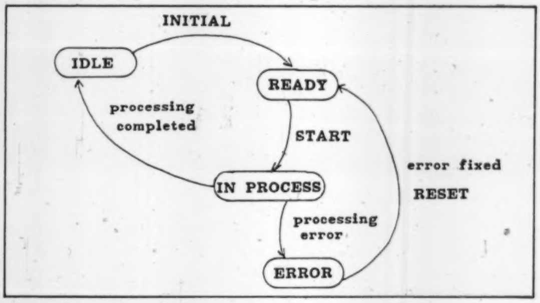


PROCESS
MACHINE
DIRTY DISHES
DETERGENT
WATER
DISH CLOTH
WASH
CLEAN DISHES
ERROR
INITIAL
START
RESET
READY IN PROCESS ERROR
INITIAL
START
RESET

A Process as a Machine Controlled by Push-buttons

Programming Concepts

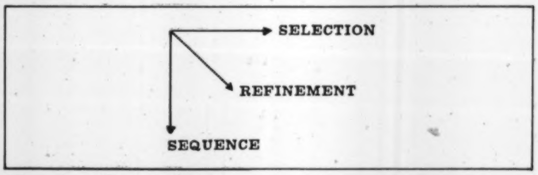
After considering the WASH process as a pushbutton machine, it is a simple matter to present the logic of a process as the following state transition diagram.



INITIAL
IDLE
READY
processing completed
START
IN PROCESS
error fixed
RESET
processing error
ERROR

State Transition Diagram

To introduce the basics of programming, a modified form of "dimensional flowcharting" as described by Witty[1] is utilized. This flowcharting format is accomplished by using three drawing directions for indicating sequences of actions, selection of alternative actions and refinement of larger actions into a sequence of actions. These rules are easily remembered from this picture.



SELECTION
REFINEMENT
SEQUENCE

Flowchart Conventions

These concepts are motivated step-by-step but we can see as the final example, the use of the rules for program-like representation of the WASH process with declarations and procedures appears in Figure 1.

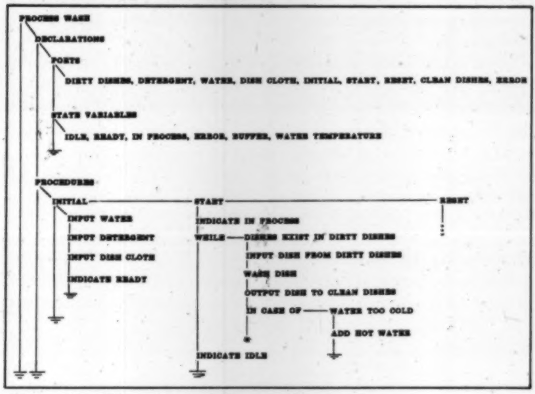

PROCESS WASH
DECLARATIONS
PORTS
DIRTY DISHES, DETERGENT, WATER, DISH CLOTH, INITIAL, START, RESET, CLEAN DISHES, ERROR
STATE VARIABLES
IDLE, READY, IN PROCESS, ERROR, BUFFER, WATER TEMPERATURE
PROCEDURES
INITIAL
INPUT WATER
INPUT DETERGENT
INPUT DISH CLOTH
INDICATE READY
START
INDICATE IN PROCESS
WHILE
DISHES EXIST IN DIRTY DISHES
INPUT DISH FROM DIRTY DISHES
WASH DISH
OUTPUT DISH TO CLEAN DISHES
IN CASE OF
WATER TOO COLD
ADD HOT WATER
*
INDICATE IDLE
RESET

Figure 1. Flowchart of Process Logic

Your intuition should help in understanding this representation with the knowledge that the ground symbol (⏚) is used to show a sequence termination and the asterisk (*) is used to show the end of a repetitive sequence controlled by a condition at the beginning of the sequence.

At this point, enough has been presented indirectly about computing concepts in the context of the model processes that the student has achieved a basic understanding and confidence. The scope of the material described thus far has permitted the following vocabulary of concepts and terms to be understood (presented here in groupings of individual chapters).

process (task)
process outputs
processor
cooperating processes
concurrent processes
interrupt
process creation
process initiation
process resumption
parallel processes
process inputs
process execution
system
uni-processor
multi-processors
process priority
process suspension
process termination
processor assignment

data
information processing system
alphabet
port
output port
transmission
simplex
half-duplex
information
data processing system
storage
input port
storage process
channels
duplex

control
speed (time) independent
speed (time) dependent
error conditions
system constraints
consuming process
monitor process
clock signal
process (machine) state
asynchronous control
synchronous control
signals
buffer
producing process
resource
resource ownership
process initialization

---

1) "Dimensional Flowcharting," Robert W. Witty, *Software Practice and Experience*, Vol. 7, 553-584 (1977).

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Card graphics and fast, expert play. Real Gin, knocking at ten points or less. Keeps score to game level. The disk version keeps score from game to game, so you can start another session where you left off. TRS-80 Mod I/III Cass. $16.95, Mod I Disk $21.95. Atari Cass. (24K) $19.95, Disk $24.95.

Cribbage Master

Excellent screen graphics, and plays hard for every point. Makes no counting mistakes, and will Muggins you if you do. User engineered for easy play, with order of cards shown for in-play scoring. Cassette version will not run in Disk Basic. TRS-80 Mod I/III Cass. $14.95, Mod I Disk $19.95. Atari version available soon.

Casino Blackjack/Counter

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Note: Append only requires 48K and DOS.

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CIRCLE 259 ON READER SERVICE CARD

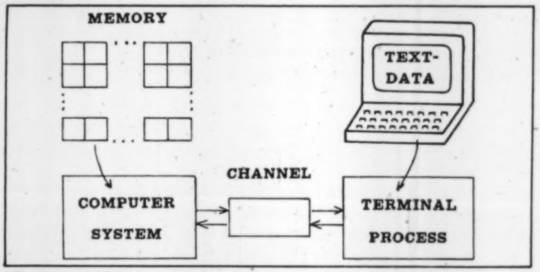
Concepts and Terminology, continued...

state transitions
finite state machine
state indicators
sequence
refinement
flowcharts (flowdiagrams)
declarations
state transition diagram
local storage
state variables
selection
program (algorithm)
repetitive sequence
procedures

How many of us mastered so many concepts in so short a period of time when we began. In classical approaches to education (including self education) in this area, many of these concepts are learned only after many hours, days, weeks, months (dare we say years) of struggling with details. It is not uncommon that the details that have been learned are then a deterrent to gaining a clear picture of these more basic, general concepts.

Introducing the Real Thing

We now begin to consider, more concretely, the data processed by computer systems by introducing the terminal and the computer system in the following, now familiar, framework.


MEMORY
TEXT-
DATA
CHANNEL
COMPUTER
SYSTEM
TERMINAL
PROCESS

Terminal Connection to a Computer System

It is easy to convince the student that by pushing buttons, data is transmitted across the channel and placed in a memory where it is processed, and results are sent back for display on the terminal screen. At this point, we still treat the computer as a "black box." The terminal process is used to transmit data back and forth.

In making "data" a more concrete concept, the nature of numbers of base 2 and 10 is presented including an easy-to-comprehend algorithm for the process of converting a binary number to a decimal number as indicated in Figure 2.

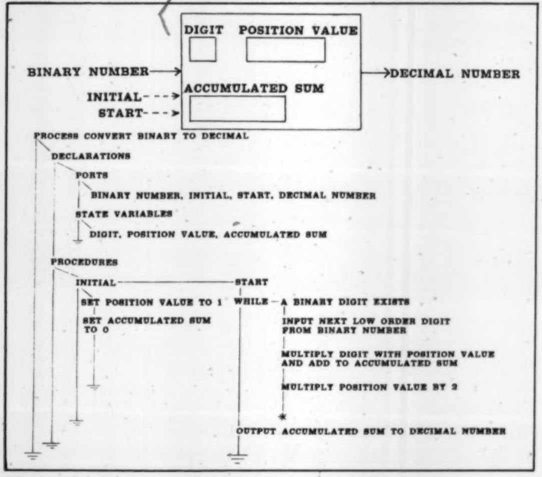

DIGIT
POSITION VALUE
BINARY NUMBER
DECIMAL NUMBER
ACCUMULATED SUM
INITIAL
START
PROCESS CONVERT BINARY TO DECIMAL
DECLARATIONS
PORTS
BINARY NUMBER, INITIAL, START, DECIMAL NUMBER
STATE VARIABLES
DIGIT, POSITION VALUE, ACCUMULATED SUM
PROCEDURES
INITIAL
START
SET POSITION VALUE TO 1
SET ACCUMULATED SUM TO 0
WHILE
A BINARY DIGIT EXISTS
INPUT NEXT LOW ORDER DIGIT FROM BINARY NUMBER
MULTIPLY DIGIT WITH POSITION VALUE AND ADD TO ACCUMULATED SUM
MULTIPLY POSITION VALUE BY 2
OUTPUT ACCUMULATED SUM TO DECIMAL NUMBER

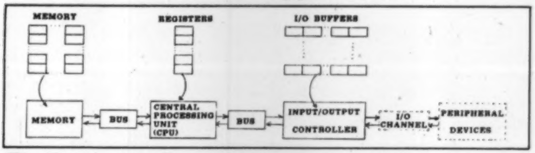
Figure 2. Binary to Decimal Conversion Process

After having mastered the WASH process from the earlier example, this process does not in any way seem strange and can be traced by following the dimensional flowchart and indicating resulting changes of the process state variables given within the process.

Further details on electronic representation of signals, precision of arithmetic data and the ASCII character set are easily introduced. Word processing systems and the representation of programs as text are followed by the presentation of basic data structure concepts including arrays.

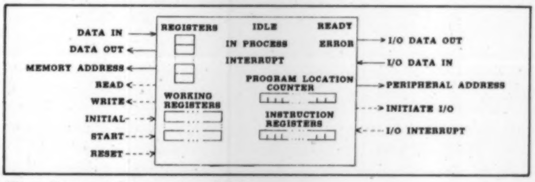
The More Conventional View

The stage has now been set to accept the computer system as simply a collection of cooperating processes connected by channels as seen in the following picture.


MEMORY
REGISTERS
I/O BUFFERS
MEMORY
BUS
CENTRAL PROCESSING UNIT (CPU)
BUS
INPUT/OUTPUT CONTROLLER
I/O CHANNEL
PERIPHERAL DEVICES

The Cooperating Processes of a Computer System

These constituent parts and their general properties are now easy to introduce. In fact, the CPU viewed as a process is eventually portrayed as follows:


DATA IN
DATA OUT
MEMORY ADDRESS
READ
WRITE
INITIAL
START
RESET
REGISTERS
IDLE
READY
IN PROCESS
ERROR
INTERRUPT
PROGRAM LOCATION COUNTER
WORKING REGISTERS
INSTRUCTION REGISTERS
I/O DATA OUT
I/O DATA IN
PERIPHERAL ADDRESS
INITIATE I/O
I/O INTERRUPT

The Central Processing Unit

A CPU state transition diagram and CPU process dimensional flowchart provide an easy guide to understanding CPU operation. A brand name independent simple instruction repertoire and assembly program presentation then makes the point about concrete programs and their execution.

Memories and Peripheral Devices

Memories of the core and semiconductor type are presented along with the structure of a flip/flop element as a process with its related process dimensional flowchart as shown in Figure 3.

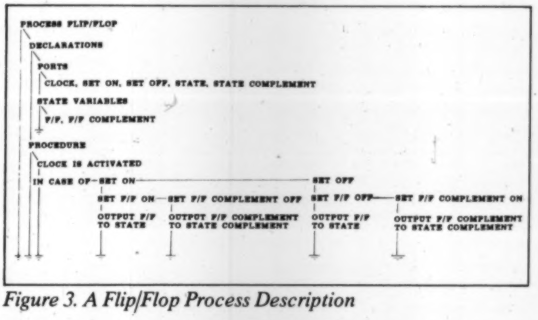

PROCESS FLIP/FLOP
DECLARATIONS
PORTS
CLOCK, SET ON, SET OFF, STATE, STATE COMPLEMENT
STATE VARIABLES
F/F, F/F COMPLEMENT
PROCEDURE
CLOCK IS ACTIVATED
IN CASE OF
SET ON
SET OFF
SET F/F ON
SET F/F COMPLEMENT OFF
SET F/F OFF
SET F/F COMPLEMENT ON
OUTPUT F/F TO STATE
OUTPUT F/F COMPLEMENT TO STATE COMPLEMENT
OUTPUT F/F TO STATE
OUTPUT F/F COMPLEMENT TO STATE COMPLEMENT

Figure 3. A Flip/Flop Process Description

Now that we are convinced that the process concept can be used as a common denominator to explain both hardware and software concepts. Storage and peripheral devices (tapes, disks, A/D and D/A converters, printers, etc.) are then described in a rather conventional manner.

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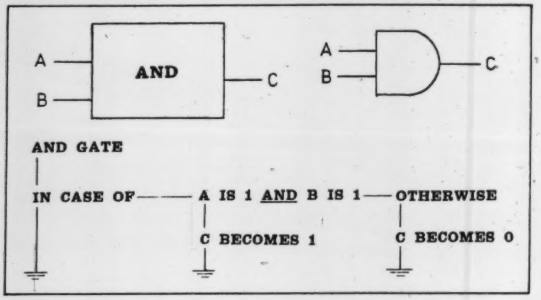
CIRCLE 196 ON READER SERVICE CARD

Concepts and Terminology, continued...

Digital Processes and Hardware Construction

Even the smallest of computer elements (gates) are presented as processes with related process logic as indicated in the following example.

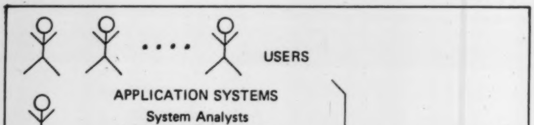

A
B
AND
C
A
B
C
AND GATE
IN CASE OF
A IS 1 AND B IS 1
OTHERWISE
C BECOMES 1
C BECOMES 0

The principles of computer arithmetic are considered, including the view of a binary adder in process form. The notions of combinational and sequential circuits are conveniently introduced along with a basic explanation of clock signals and timing.

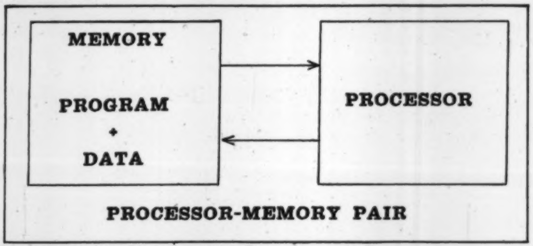
These digital building blocks and their eventual encapsulation into integrated circuits, printed circuit boards and chassis are easily described with this background.

Putting it All Together

The process concept has enabled us to present basic computer system concepts, the notion of programming and the composition of computer hardware. Putting this all together, we then create the notion of "architecture," starting with basic delineation between hardware and software architecture as follows.

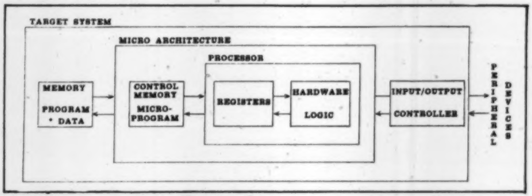

USERS
APPLICATION SYSTEMS
System Analysts
Application Programmers
DATA BASE SYSTEM
Data Base Programmers
LANGUAGE TRANSLATORS
Compiler Writers
OPERATING AND FILE SYSTEMS
System Programmers
TARGET SYSTEM ARCHITECTURE
Machine Language Programmers
MICRO ARCHITECTURE
Microprogrammers
COMPUTER CIRCUITS
Logic Designers
INTEGRATED CIRCUITS
Circuit Designers
Solid State Physicists
SOFTWARE
ARCHITECTURE
HARDWARE
ARCHITECTURE

A further key concept, namely that of "processor-memory pairs" as illustrated in the following provides the keystone to describing the various architectural levels.


MEMORY
PROGRAM
+
DATA
PROCESSOR
PROCESSOR-MEMORY PAIR

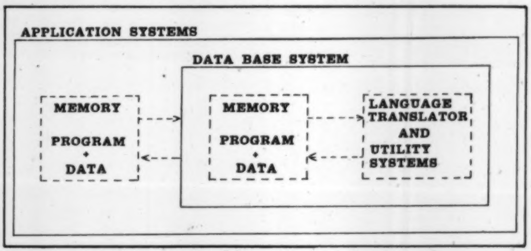
The Basis for Constructing Programmed Processes

The architecture of the target system (programmer's machine language machine) can then be described abstractly as nested pairs of processors and memories as indicated in the following.


TARGET SYSTEM
MICRO ARCHITECTURE
PROCESSOR
MEMORY
PROGRAM
+ DATA
CONTROL
MEMORY
MICRO-
PROGRAM
REGISTERS
HARDWARE
LOGIC
INPUT/OUTPUT
CONTROLLER
PERIPHERAL
DEVICES

Architecture of the Target System

This nesting is built upon to describe further the placement and role of operating and file systems, language translators, utility systems, and data bases, and culminates in the following view of the relationship between the application system and the lower level systems of cooperating processes.


APPLICATION SYSTEMS
DATA BASE SYSTEM
MEMORY
PROGRAM
+
DATA
MEMORY
PROGRAM
+
DATA
LANGUAGE
TRANSLATOR
AND
UTILITY
SYSTEMS

Application Systems Architecture

Note: the dotted lines around the memory simply denote that it is not a separate physical memory but is a program and data representation in a common physical memory.

Further architectural concepts such as multi-port memories, DMA channels and common busses (highways) can be introduced in a natural manner as architectural alternatives. Finally, the concepts of network architectures and related terminology round off his brief (but comphehensive) introduction to the "core" concepts and terminology of computer systems.

Experience with the Approach

The approach described here has been tested and proved to be successful for a variety of audiences. For those seeking a starting point in learning about computer systems (amateurs and professionals to be) the approach permits an examination of the nature of the forest before examining the leaves of the trees. As an appreciation (computer literacy) vehicle the approach has worked successfully for journalists, politicians

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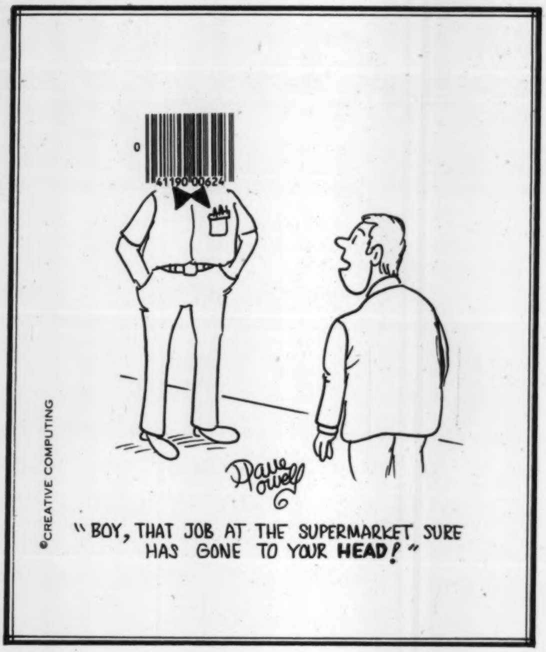
and administrative and technical people. We have also been successful in removing the fear of secretaries who are learning to use word processing systems. Terminal operators of all varieties would certainly benefit from the understanding provided here. They get an idea of where they fit into the system that they are using and some idea of what is happening in the computer.

The demystification of the computer is a must if we hope to achieve any degree of harmony between technology and the citizenry of the world. This approach, which has been or is in the process of being translated into a variety of languages,, provides a step in the right direction.

Some Final Comments

It is important to note that the approach is described in a completely product independent manner, therefore, the approach can be used to complement the real details of any product. Teaching assistance materials, including visual aids, are available and are quite useful for presenting the approach to small as well as large groups. The approach is well suited to being supported by animation and plans are being made to provide and animated video tape and animation via software for commonly available microcomputers.

Understanding Computer Systems can be ordered in single copies by sending a check in US dollars for $15.25 ($17.25 for airmail) to LAWSON, Gustav Adolfsgatan 9, 582, 20, Linkoping, Sweden. Make checks payable to LAWSON. All other inquires can be directed to the same address. ☐



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Illustrations by Stan Gilliam

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MAXI-PROS has both global and line edit capability and the polled keyboard versions contain a corrected keyboard routine that make the OSI keyboard decode as a standard typewriter keyboard.

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It does have some limitations. It is memory hungry — 8K is the minimum sized system that can run the Compiler. It also handles only a limited subset of Basic — about 20 keywords including FOR, NEXT, IF THEN, GOSUB, GOTO, RETURN, END, STOP, USR(X), PEEK, POKE, -,=,*,/,(,),<,>,Variable names A-Z, and Integer Numbers from 0-64K.

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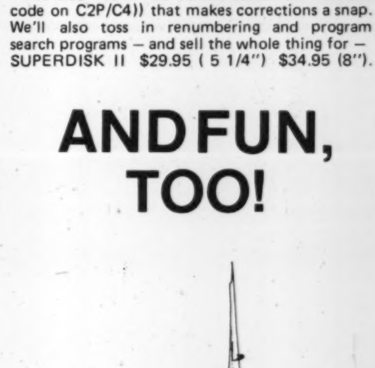

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A Visit to the Marin Computer Center

COMPUTERS are for PEOPLE

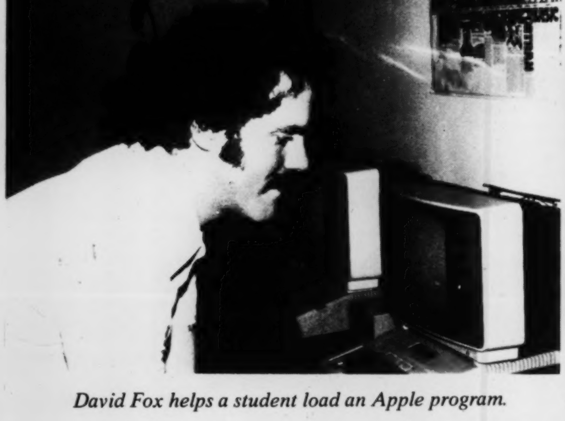
Betsy Staples

"Computers are for kids" says a poster hanging on the wall outside our Software Development Center. After visiting the Marin Computer Center, just north of San Francisco, this spring, I wished I'd had another copy to send to David and Annie Fox, the dedicated young couple who run the Center.

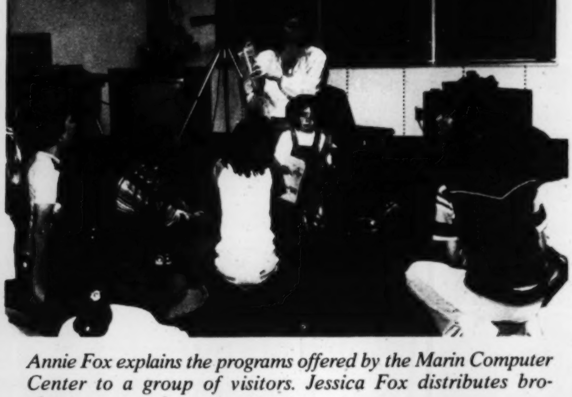
We dropped in unannounced on a Tuesday morning and found a large, open "flexible classroom" filled with Apples, PETs, Ataris, SOLs, and kids. The kids, who appeared to be in about fourth grade, were participating in the field trip program which allows teachers to bring their classes to the Center for a morning or afternoon of exposure to computing.

In addition to field trips, the Marin Computer Center offers classes in programming for children and adults, and "open time" when people can come in and buy time on the computer of their choice by the hour. There is also an area where a word processing system, complete with letter-quality printer, may be rented by the hour.

The Foxes have found that many of the children who have their first exposure to computers on a field trip become regular customers, and often involve other



David Fox helps a student load an Apple program.



Annie Fox explains the programs offered by the Marin Computer Center to a group of visitors. Jessica Fox distributes brochures.

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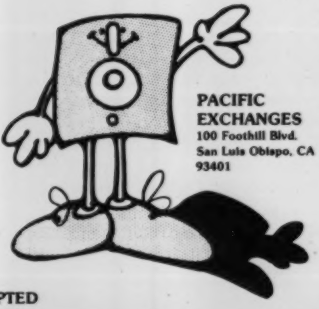

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members of their families in the programs offered at the Center.

"Our first objective is to provide a place for people to meet computers," says David. He adds that "now when Annie asks a group of kids, 'who has played with computers before?' only about 10% haven't. When she asked the same question three years ago, only one or two in a group of 30 had ever touched a computer."

The Center is not just for kids, however. "Adults," says David "need a lot more introduction than kids. We started because three years ago we found that this was a definite need. People had to find some place where they could get some exposure and ease into computing without being afraid of it."

"I have a beginning class for adults that meets in the evening," says Annie, "and it's always packed. Some of them have already purchased machines and as an afterthought they decide they had better learn how to use them, so they take the class. Others take the course to become more familiar with the jargon before going to talk to a computer salesman."

The enthusiasm of children using computers at the Center is contagious.

Computers are Fun

When asked about her feelings toward computers, Annie says, "I think they're a lot of fun. The kids I see working with them seem to be very turned on by the new way that computers allow them to express themselves. It seems to involve a different part of their minds."

What kind of child is turned on in this way? "I'm talking about kids that write programs. I teach programming to kids as young as fourth grade. They really get into the puzzling aspect of it. They're usually very bright kids who enjoy figuring things out, enjoy feeling the power the computer gives them."

"What kinds of programs do they write?" we asked.

"I have a five-week after school class where I teach Basic and some simple graphics. Usually the kids are writing interactive story type programs or programs where a person is involved in a setting and has to make a choice. The children get very involved in the fantasy of it, but the thing they enjoy most is having the other students play their games."

Do they concentrate primarily on games? Annie responds, "we use the games to get people involved, but I find that everybody has a saturation point, and most of the people who return to the Computer Center like to get into programming on some level or another."

What about the game critics—those who feel computer games are a waste of time? How does Annie counter their criticism?

"I regularly demonstrate some of the logic games to groups of teachers, and so far, there are only a few I haven't won over. They are aware that there is some learning going on when a child solves a problem such as the Towers of Hanoi or Leap Frog—problems where a strategy must be planned. The teachers, however, don't have conventional labels for that kind of learning process, so they have trouble with it.

Most of the people who return to the Computer Center like to get into programming on some level or another.

"Many teachers, on the other hand, have become more educated in what it means to educate someone. I don't know what is happening back East, but around here schools are closing and teachers are being laid off left and right. I find that many teachers are intrigued by computers. They anticipate being laid off and are looking for new careers, but they remain, first and foremost, educators. I think many of them will become involved in the development of good educational software."

Funding

The original funding for the Marin Computer Center was a bank loan co-signed by a friend of the Foxes. Recently, however, the non-profit organization has been the recipient of generous grants from a Marin County foundation which is bound by the terms of a bequest to spend all of its money in the county.

Among other things, the grants pay for two teachers to take computers into classrooms in the county. "We go on a need basis," David explains. "We look for schools that don't have computer programs; schools that are in low income areas."

"We also find schools that purchased computers without any thought as to what would happen when the machine arrived. They didn't train their personnel and didn't buy any software, and now the machines are sitting in the math teacher's closet gathering dust," adds Annie.

"We offer workshops to help these schools get involved. We make it easy for them; they don't have to pay anything for our services. We also work with schools that are still considering the purchase of computer equipment to give them an appreciation of what it will mean to incorporate a computer in their curriculum.

David adds that "the grant pays for approximately 1000 youngsters to attend a six-session course which provides nine hours of instruction."

The Center has also received support from the computer divisions of Atari Inc. and Commodore who have provided several computers on long-term loan.

"Of all the computer companies," David

A fourth grade class visits the Marin Computer Center on a field trip.

says, "Atari seems to be the most helpful. Everyone I have talked to at Atari has really been supportive; I am really impressed with the way they work with the consumer."

Perhaps, in part, because of their good relationship with Atari, the Foxes recently purchased 12 Atari 800s and six Atari 400s. Eight of them will be used for the school visitation program, and the rest will be housed in the "Atari Room" at the Center.

There are also quite a few Apples in use at the Center. These are connected to a hard disk system which eliminates the need for repeated loading of individual floppy disks. The problem with this is that "most of the really good games are copy-protected so we can't put them on the hard disk."

David says he thought about finding a way around the various copy-protect schemes, but decided that the benefits did not justify endangering the reputation of the Center with software manufacturers. "We use floppy disk drives for those games and just boot them up. It's not a major problem, it's just too bad."

And speaking of software, what are the most popular games?

"Right now," says David, "the ones that are in the arcades are popular—Asteroids, Space Invaders, Star Raiders. The Adventure games such as Temple of Apshai, Morlock's Tower, and the Scott Adams Adventures are also among the favorites."

The Marin Computer Center, located at 50 El Camino Dr., Corte Madera, CA 94925, is open to everyone. Rates range from $2.25 per hour for members using the regular computers to $7.50 per hour for non-members using the word processing system. The phone number is 415-924-1955. ☐

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CP/M Disks/Diskettes

CARD GAMES

BRIDGE 2.0 (Available for all computers) **Price: $17.95 Cassette/$21.95 Diskette**
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice. See the software review in 80 Software Critique.

HEARTS 1.5 (Available for all computers) **Price: $15.95 Cassette/$19.95 Diskette**
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies. HEARTS 1.5 is an ideal game for introducing the uninitiated (your spouse) to computers. See the software review in 80 Software Critique.

STUD POKER (Atari only) **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and *usually* bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound.

POKER PARTY (Available for all computers) **Price: $17.95 Cassette/$21.95 Diskette**
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple Cassette and diskette versions require a 32 K (or larger) Apple II.

CRIBBAGE 2.0 (TRS-80 only) **Price: $14.95 Cassette/$18.95 Diskette**
This is simply the best cribbage game available. It is an excellent program for the cribbage player in search of a worthy opponent as well as for the novice wishing to improve his game. The graphics are superb and assembly language routines provide rapid execution. See the software review in 80 Software Critique.

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star and CP/M only) **Price: $19.95 Cassette**
$23.95 Diskette
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) **Price: $17.95 Cassette/$21.95 Diskette**
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS.

VALDEZ (Available for all computers) **Price: $15.95 Cassette/$19.95 Diskette**
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software review in 80 Software Critique.

BACKGAMMON 2.0 (Atari, North Star and CP/M only) **Price: $14.95 Cassette/$18.95 Diskette**
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 is played in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHECKERS 3.0 (PET only) **Price: $16.95 Cassette/$20.95 Diskette**
This is one of the most challenging checkers programs available. It has 10 levels of play and allows the user to change skill levels at any time. Though providing a very tough game at level 4-8, CHECKERS 3.0 is practically unbeatable at levels 9 and 10.

CHESS MASTER (North Star and TRS-80 only) **Price: $19.95 Cassette/$23.95 Diskette**
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users.

LEM LANDER (32K Apple Disk only) **Price: $16.95 Diskette**
Pilot your LEM LANDER to a safe landing on any of nine different surfaces ranging from smooth to treacherous. The game paddles are used to control craft attitude and thrust. This is a real-time high res challenge!

FOREST FIRE! (Atari only) **Price: $16.95 Cassette/$20.95 Diskette**
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! Very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

NOMINOES JIGSAW (Atari, Apple and TRS-80 only) **Price: $16.95 Cassette/$20.95 Diskette**
A jigsaw puzzle on your computer! Complete the puzzle by selecting your pieces from a table consisting of 60 different shapes. NOMINOES JIGSAW is a virtuoso programming effort. The graphics are superlative and the puzzle will challenge you with its three levels of difficulty. Scoring is based upon the number of guesses taken and by the difficulty of the board set-up.

MONARCH (Atari only) **Price: $11.95 Cassette/$15.95 Diskette**
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy.

CHOMP-OTHELLO (Atari only) **Price: $11.95 Cassette/$15.95 Diskette**
CHOMP-OTHELLO? It's really two challenging games in one. CHOMP is similar in concept to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. OTHELLO is the popular board game set to fully utilize the Atari's graphics capability. It is also very hard to beat! This package will run on a 16K system.

DYNACOMP OFFERS THE FOLLOWING

- Widest variety
- Guaranteed quality
- Fastest delivery
- Friendly customer service
- Free catalog
- 24 hour order phone

AND MORE...

STARTREK 3.2 (Available for all computers) **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

BLACK HOLE (Apple only) **Price: $14.95 Cassette/$18.95 Diskette**
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

SPACE TILT (Apple and Atari only) **Price: $10.95 Cassette/$14.95 Diskette**
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

MOVING MAZE (Apple only) **Price: $10.95 Cassette/$14.95 Diskette**
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

ALPHA FIGHTER (Atari only) **Price: $14.95 Cassette/$18.95 Diskette**
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) **Price: $16.95 Cassette/$20.95 Diskette**
The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

INTRUDER ALERT (Atari only) **Price: $16.95 Cassette/$20.95 Diskette**
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

GIANT SLALOM (Atari only) **Price: $14.95 Cassette/$18.95 Diskette**
This real-time action game is guaranteed addictive! Use the joystick to control your path through slalom courses consisting of both open and closed gates. Choose from different levels of difficulty, race against other players or simply take practice runs against the clock. GIANT SLALOM will run on 16K systems.

TRIPLE BLOCKADE (Atari only) **Price: $14.95 Cassette/$18.95 Diskette**
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari and North Star only) **Price: $11.95 Cassette/$15.95 Diskette**
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) **Price: $21.95 Diskette**
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 40 countries). During the past two years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique and A.N.A.L.O.G. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

**ATARI, PET, TRS-80, NORTHSTAR, CP/M and IBM are registered tradenames and/or trademarks.*

***TRS-80 diskettes are not supplied with DOS or BASIC.*

BUSINESS and UTILITIES

SPELLGUARD™ (CP/M only) **Price: $369.95 Disk**
SPELLGUARD is a revolutionary new product which increases the value of your current word processing system (WORDSTAR, MAGIC WAND, ELECTRIC PENCIL, TEXTED EDITOR II and others). Written entirely in assembly language, SPELLGUARD™ rapidly assists the user in eliminating spelling and typographical errors by comparing each word of the text against a dictionary (expandable) of over 20,000 of the most common English words. Words appearing in the text but not found in the dictionary are "flagged" for easy identification and correction. Most administrative staff familiar with word processing equipment will be able to use SPELLGUARD™ in only a few minutes.

MAIL LIST 2.2 (Apple, Atari and North Star diskette only) **Price: $34.95**
This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing, merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. Mail List 2.2 will even find and delete duplicate entries. A very valuable program!

FORM LETTER SYSTEM (FLS) (Atari, Apple and North Star diskette only) **Price: $21.95**
Use FLS to create and edit form letters and address lists. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $49.95.

SORTIT (North Star only) **Price: $29.95 Diskette**
SORTIT is a general purpose sort program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

PERSONAL FINANCE SYSTEM (Atari and North Star only) **Price: $34.95 Diskette**
PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations.

FAMILY BUDGET (Apple only) **Price: $34.95 Diskette**
The FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. The FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data is easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

THE COMMUNICATOR (Atari only) **Price: $49.95 Diskette**
This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (*e.g.*, The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

DYNACOMP also supplies THE COMMUNICATOR with an Atari 830 modem for a combined price of $219.95. The modem is available separately for $189.95.

TEXT EDITOR II (CP/M) **Price: $29.95 Diskette/$33.45 Disk**
This is the second release version of DYNACOMP's popular TEXT EDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

DFILE (Atari and North Star only) **Price: $19.95**
This handy program allows North Star and Atari disk users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

FINDIT (North Star only) **Price: $19.95**
This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

GRAFIX (TRS-80 only) **Price: $14.95 Cassette/$18.95 Diskette**
This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) **Price: $19.95 Cassette/$23.95 Diskette**
Let HODGE PODGE be your child's baby sitter. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 9. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education.

TEACHER'S PET I (Available for all computers) **Price: $11.95 Cassette/$15.95 Diskette**
This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

MORSE CODE TRAINER (TRS-80 only) **Price: $12.95 Cassette/$16.95 Diskette**
MORSE CODE TRAINER is designed to develop and improve your speed and accuracy in deciphering Morse Code. As such, MCT is an ideal software package for FCC test practice. The code sound is obtained through the earphone jack of any standard cassette recorder. You may choose the pitch of the tones as well as the word rate. Also, various modes of operation are available including number, punctuation and alphabet tests, as well as the keying of your own message. A very effective way to learn code!

MISCELLANEOUS

CRYSTALS (Atari only) **Price: $ 9.95 Cassette/$13.95 Diskette**
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) **Price: $29.95 Cassette/$33.95 Diskette**
DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) **Price: $14.95 Cassette/$18.95 Diskette**
This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) **Price: $16.95 Cassette/$20.95 Diskette**
Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) **Price: $19.95 Cassette/$23.95 Diskette**
This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) **Price: $24.95 Cassette/$28.95 Diskette**
HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $49.95 (three cassettes) and $59.95 (three diskettes).

REGRESSION I (Available for all computers) **Price: $19.95 Cassette/$23.95 Diskette**
REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) **Price: $19.95 Cassette/$23.95 Diskette**
PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) **Price: $24.95 Cassette/$28.95 Diskette**
MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Available for all computers) **Price: $39.95 Cassette/$43.95 Diskette**
In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volume I (Not available for Atari)
DYNACOMP is the exclusive distributor for the software keyed to the popular text *BASIC Scientific Subroutines, Volume I* by F. Ruckdeschel (see the BYTE/McGraw-Hill advertisement in BYTE magazine, January 1981). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Collection #1: Chapters 2 and 3: Data and function plotting, complex variables
Collection #2: Chapter 4: Matrix and vector operations
Collection #3: Chapters 5 and 6: Random number generators, series approximations
Price per collection: $14.95 Cassette/$18.95 Diskette

All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).
Because the text is a vital part of the documentation, *BASIC Scientific Subroutines, Volume I* is available from DYNACOMP for $19.95 plus 75¢ postage and handling.

ROOTS (Available for all computers) **Price $10.95 Cassette/$14.95 Diskette**
In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

ACTIVE CIRCUIT ANALYSIS (ACAP) (48K Apple only) **Price: $25.95/$29.95 Diskette**
ACAP is the analog circuit designer's answer to LOGIC SIMULATOR. With ACAP you may analyze the response of an active or passive component circuit (e.g., a transistor amplifier, band pass filter, etc.). The circuit may be probed at equal steps in frequency, and the resulting complex (i.e., real and imaginary) voltages at each component juncture examined. By plotting the magnitude of these voltages, the frequency response of a filter or amplifier may be completely determined with respect to both amplitude and phase. In addition, ACAP prints a statistical analysis of the range of voltage responses which result from tolerance variations in the components.

ACAP is easy to learn and use. Simply describe the circuit in terms of the elements and their placement, and execute. Circuit descriptions may be saved onto cassette or diskette to be recalled at a later time for execution or editing. ACAP should be part of every circuit designer's program library.

LOGIC SIMULATOR (Apple only; 48K RAM) **Price: $24.95 Cassette/$28.95 Diskette**
With LOGIC SIMULATOR you may easily test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. The response of the system is available every clock cycle. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. At the user's option, a timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

LOGIC DESIGNER (North Star and CP/M only) **Price: $34.95 Diskette**
LOGIC DESIGNER is an exceptional Computer Aided Design (CAD) program. With it you may convert a large and complicated digitial truth table (the functional specification) into an optimized Boolean logic equation. This equation may then be *easily* converted into a circuit design using either NAND or AND/OR gates. Operationally, LOGIC DESIGNER is composed of a BASIC program which calls in a machine language routine to reduce execution time. Example: For a 7 variable by 127 line table, the processing time is only two minutes. LOGIC DESIGNER is clearly a fast and powerful tool for building digital circuitry.

ORDERING INFORMATION

All orders are processed and shipped within 48 hours. Please enclose payment with order and include the appropriate computer information. If paying by VISA or Master Card, include all numbers on card.

Shipping and Handling Charges
Within North America: Add $1.50
Outside North America: Add 10% (Air Mail)

Delivery
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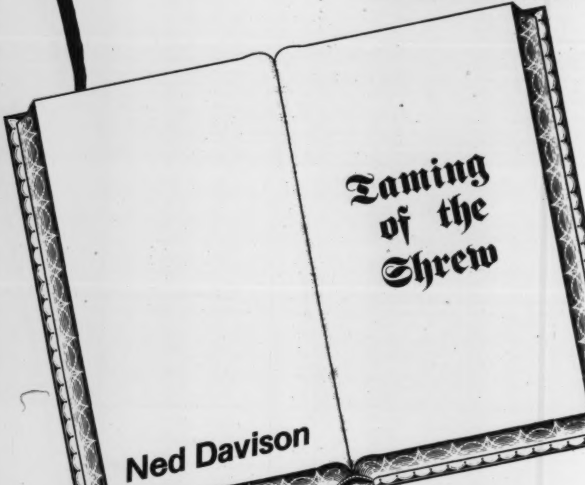
Nursery Rhymes to Shakespeare: Using a Text Editor to Look at Literature



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lost their mittens
and they began to cry

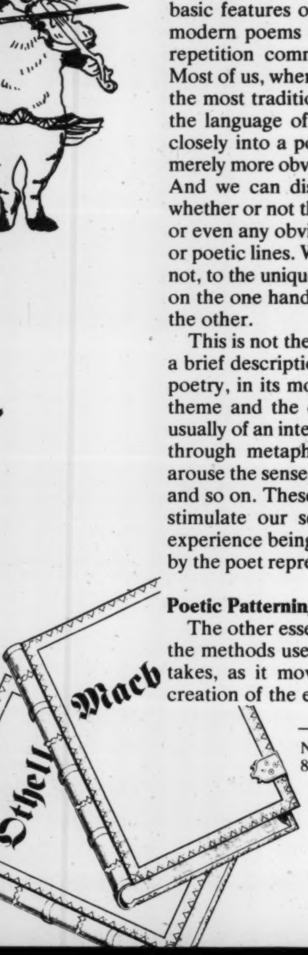
Computers are ideal for pattern-searching, and if it is true that literature is highly patterned language then a computer should be very useful for studying configuration in literary works.

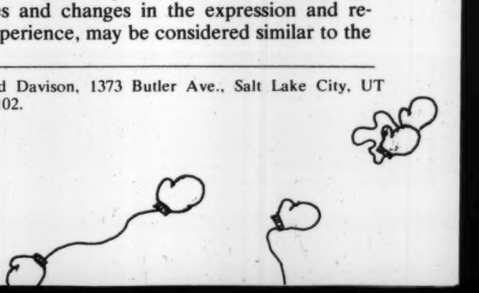
Take our nursery rhyme above, for example. It has all the basic features of most poems. There is rhyme (which many modern poems do not have, or course) and other kinds of repetition common to both rhymed and unrhymed verse. Most of us, when we think of poetry, think first of end-rhyme, the most traditional difference between poetic language and the language of everyday use. When we look a little more closely into a poem, we discover very quickly that rhyme is merely more obvious than some of the other types of patterning. And we can distinguish a piece of language that is verse, whether or not that language has any end-rhyme in its makeup or even any obviously discernible regularity of phrase lengths or poetic lines. We manage this by responding, consciously or not, to the uniquely intensified patterning of its verbal materials on the one hand, and to its figurative or symbolic density on the other.

This is not the place to attempt to define poetry. However, a brief description may be useful. I think it is safe to say that poetry, in its most basic form, is both the development of a theme and the creation of a unique structure. The theme, usually of an intensely personal or emotional nature, is realized through metaphor and images of all sorts—elements that arouse the senses of sight, touch, taste, smell, hearing, motion and so on. These devices of comparison and description that stimulate our senses and enable us to participate in the experience being communicated to us, or being aroused in us by the poet represent a major characteristic of poetic writing.

Poetic Patterning

The other essence of the poem is found in its structure and the methods used to build the poem. The form the language takes, as it moves and changes in the expression and re-creation of the experience, may be considered similar to the





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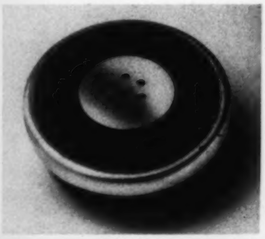

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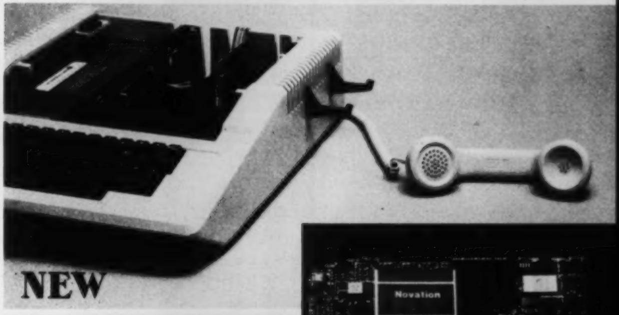

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structuring of a musical composition. Poems and musical pieces are, of course, not the same thing, but they do have a very important common characteristic. Both develop within the media of sound and time. They are, in one way or another, performed sequentially, and the sequence reveals many different sorts of recurring elements and a great variety of repetition. The patterning that results is one of the major sources of a poem's effectiveness and of the pleasure we associate with reading verse.

It is only natural that a more acute perception of the repetitions and patterning of literature, and especially poetry, would or should provide us with not only a better understanding of how literature works and how it is made, but it should also tend to intensify and enhance our appreciation of literary language, the poet's skill, and the poetic experience itself.

The computer now offers us the possibility of examining literary structuring with a precision and incisiveness previously unimagined.

This is where the computer comes in. Listeners and readers of literature have, since the beginnings of history, been sensitive to such patterning. Some of the most perceptive have chosen to comment on that patterning in various ways. With few exceptions, however, those "critics" have had to rely on intuition and memory. The computer now offers us the possibility of examining literary structuring with a precision and incisiveness previously unimagined. It also enables us to look at the interplay and relationships among a variety of different elements, all woven together into a pattern of extraordinary complexity. Human memory and our notepads have simply been inadequate for the detailed and sustained sort of analysis or "unravelling" of configurations that the artistic sensibility manages to produce under the spell of literary inspiration.

The use of computers as an aid to the study of literature has been a relatively recent development. Deciphering the mysteries of language itself has stimulated a good deal more activity, and the early failures of linguists to resolve the problems that natural languages present to computer adaptation have led to a renaissance in the study of the nature of language itself. Out of the early disappointments have come new techniques and new knowledge that should help us greatly in the future.

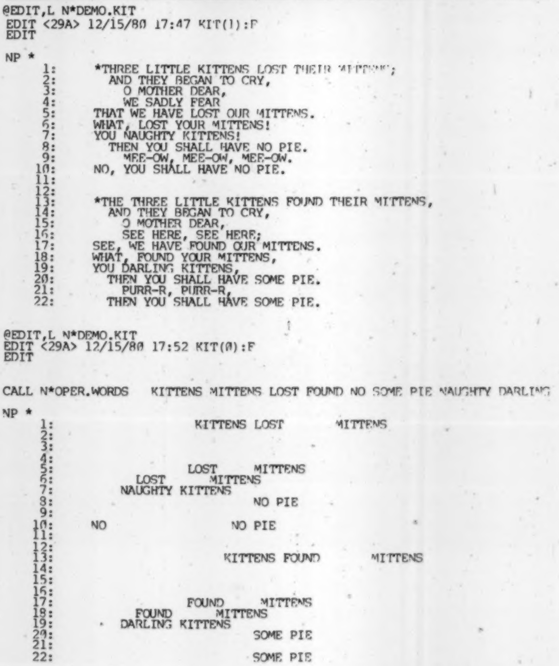
In the spring of 1980, two very fine books devoted to literary and humanistic computing appeared: Robert Oakman's *Computer Methods in Literary Research*, U. of South Carolina Press, and Susan Hockey's *A Guide to Computer Applications in the Humanities*, Johns Hopkins. Anyone interested in the background of literary computing, its current activities and techniques, will enjoy both of these books. If you read either of them, however, you will quickly notice that literary computing on an interactive, individualized basis—where the person interested in literary structure can communicate spontaneously with a text—has been explored very little. And that fact opens up to the world of the small computer a wide horizon of possibilities.

Interactive Communication

My work has been consistently directed toward interactive communication with poetic works—although it has been carried out on a large computer, a UNIVAC 1108/1160. The concepts are very susceptible nonetheless to conversion to personal computers. Many of the programs (they are really macros written within the programming capability of the UNIVAC University of Maryland text editor) are of a very simple design, yet are surprisingly useful. Let's take a look at some of them.

The first one in Figure 1, I call WORDS, and its design is very straightforward. The user simply brings up a text, and by calling the program—along with the appropriate variables (words or phrases of word-fragments)—causes all text except the selected strings to be converted to blanks. Figure 1 shows the results of this operation, and may call to your attention some aspects of structuring of pattern of which you might not have been aware in this very, very familiar nursery rhyme. To give you a more substantial sample of literature, I have added also a sonnet of Edna St. Vincent Millay, where the same WORDS program has been used. You can see at a glance the basic conceptual pattern of the piece. Traditional forms lend themselves especially well to this sort of demonstration because the internal configurations of classical meters are often unusually intensified. Selective displays such as these can be useful to a student as well as to the literary investigator.

Another example of a simple interactive macro within the text editor capabilities of the UNIVAC, and again one that could be adapted to a personal computer, is a program devised to provide an instant search, on a longer literary text, for specific words, expressions, or other phrase units (collocations). This program provides, in a fragmentary way, the kinds of information that are customarily handled by large and completely integrated concordance programs. The



```
@EDIT,L N*DEMO.KIT
 EDIT <29A> 12/15/80 17:47 KIT(1):F
 EDIT

 NP *
      1:      *THREE LITTLE KITTENS LOST THEIR MITTENS;
      2:        AND THEY BEGAN TO CRY,
      3:          O MOTHER DEAR,
      4:          WE SADLY FEAR
      5:      THAT WE HAVE LOST OUR MITTENS.
      6:      WHAT, LOST YOUR MITTENS!
      7:      YOU NAUGHTY KITTENS!
      8:        THEN YOU SHALL HAVE NO PIE.
      9:          MEE-OW, MEE-OW, MEE-OW.
     10:      NO, YOU SHALL HAVE NO PIE.
     11:
     12:
     13:      *THE THREE LITTLE KITTENS FOUND THEIR MITTENS,
     14:        AND THEY BEGAN TO CRY,
     15:          O MOTHER DEAR,
     16:          SEE HERE, SEE HERE;
     17:      SEE, WE HAVE FOUND OUR MITTENS.
     18:      WHAT, FOUND YOUR MITTENS,
     19:      YOU DARLING KITTENS,
     20:        THEN YOU SHALL HAVE SOME PIE.
     21:          PURR-R, PURR-R,
     22:        THEN YOU SHALL HAVE SOME PIE.

@EDIT,L N*DEMO.KIT
EDIT <29A> 12/15/80 17:52 KIT(0):F
EDIT


CALL N*OPER.WORDS   KITTENS MITTENS LOST FOUND NO SOME PIE NAUGHTY DARLING

NP *
      1:                    KITTENS LOST       MITTENS
      2:
      3:
      4:
      5:                   LOST     MITTENS
      6:            LOST     MITTENS
      7:          NAUGHTY KITTENS
      8:                            NO PIE
      9:
     10:      NO                  NO PIE
     11:
     12:
     13:                        KITTENS FOUND       MITTENS
     14:
     15:
     16:
     17:                   FOUND    MITTENS
     18:            FOUND      MITTENS
     19:          DARLING KITTENS
     20:                            SOME PIE
     21:
     22:                            SOME PIE
```

Figure 1A. Isolating key words to show patterns.

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concordance, or a listing of all words of a text and where they occur—commonly including as well the context in which they appear—has existed for à long time. But up until recent years they have been prepared by hand. Once of the most sophisticated areas of literary computing is currently the preparation of concordance for very large bodies of text, the works of Shakespeare, Biblical concordances, and such. The variety and subtlety of programs now available for large computers are discussed in detail in the Hockey and Oakman books mentioned above.

Often, however, the investigator may be interested in only certain very specific words or phrases. The example in Figure 2 shows how a simple macro will search out lines containing two elements separated by dissimilar or similar intervening material, indicate the line number, and then preceeding and the following lines to provide the investigator with a verbal environment sufficient to assess the way in which the elements under study are used. The text used for Figure 2 was T.S. Elliot's "Four Quartets." I have developed two other programs of similiar nature, one to locate phrases of identical nature, and another to find words of related meaning, or words which represent members of a family of words (man, boy, youth, swain, etc.) in order to compare their roles in the text being examined.

```
@EDIT,L N*DEMO.LOVE
EDIT <29A> 12/15/80 20:57 LOVE(0):F
EDIT

>NP *
     1:      *  LOVE IS NOT ALL: IT IS NOT MEAT NOR DRINK
     2:      NOR SLUMBER NOR A ROOF AGAINST THE RAIN;
     3:      NOR YET A FLOATING SPAR TO MEN THAT SINK
     4:      AND RISE AND SINK AND RISE AND SINK AGAIN;
     5:      LOVE CAN NOT FILL THE THICKENED LUNG WITH BREATH,
     6:      NOR CLEAN THE BLOOD, NOR SET THE FRACTURED BONE;
     7:      YET MANY A MAN IS MAKING FRIENDS WITH DEATH
     8:      EVEN AS I SPEAK, FOR LACK OF LOVE ALONE.
     9:      IT WELL MAY BE THAT IN A DIFFICULT HOUR,
    10:      PINNED DOWN BY PAIN AND MOANING FOR RELEASE,
    11:      OR NAGGED BY WANT PAST RESOLUTION'S POWER,
    12:      I MIGHT BE DRIVEN TO SELL YOUR LOVE FOR PEACE,
    13:      OR TRADE THE MEMORY OF THIS NIGHT FOR FOOD.
    14:      IT WELL MAY BE.  I DO NOT THINK I WOULD.

*>CALL N*OPER.WORDS   NOT LOVE NOR RISE SINK DEATH IT=WELL=MAY=BE

>NP *
     1:         LOVE    NOT              NOT      NOR
     2:      NOR          NOR
     3:      NOR                                   SINK
     4:          RISE      SINK     RISE     SINK
     5:      LOVE     NOT
     6:      NOR                   NOR
     7:                                              DEATH
     8:                                 LOVE
     9:      IT=WELL=MAY=BE
    10:
    11:
    12:                                   LOVE
    13:
    14:      IT=WELL=MAY=BE        NOT
```

Figure 1B. Isolating key words to show patterns.

```
N*OPER.WORDS

.  (WRITTEN BY N.J. DAVISON)
.      [USE EDIT,D WHEN CALLING TEXT FILE]
.  USED TO ISOLATE NINE STRINGS IN A SCHEMATIC PRINTOUT WHERE ALL
.  OTHER TEXT HAS BEEN CONVERTED TO BLANKS AND BLANKS HAVE BEEN
.  CONVERTED TO "=".  THIS ENABLES SELECTIVE SEARCHES OF STRINGS
.  THAT MAY BE PARTS OF LARGER WORDS: E.G. EN  AL  Y  ETC.
.  THE WORDS ARE TYPED AS ARGUMENTS, AS FOLLOWS:  =ED=  =Y=
.  OR IF ONLY THE BEGINNING OF A WORD IS DESIRED AS THE SEARCH
.  ELEMENT:  =EN  =PENSA  =PIENS   ETC.  ALL NINE ARGUMENTS ARE
.  NOT MANDATORY.  WORD ENDINGS CAN ALSO BE SEARCHED WITH
.  THIS PROCEDURE, E.G.  ADO=  IDO=  ANDO= IENDO=  ETC.
.  THE SYNTAX  =EN=  OR  ADO=  NEED NOT BE USED IF IT IS NOT
.  NECESSARY TO DISTINGUISH WHOLE WORDS FROM ELEMENTS WITHIN
.  COMPOUND WORDS.  THUS THE CALL   N*OPER.WORDS MANO CABEZA
.  IS PERFECTLY ACCEPTABLE.
.  11/30/78
   17:      T
   18:      ON BR
   19:      CALL N*OPER.RIME
   20:      ON BR
   21:      C ;';^; A
   22:      C,* ;; ;
   23:      C ; ;=; A
   24:      C ;%1;111; A
   25:      C ;%2;222; A
   26:      C ;%3;333; A
   27:      C ;%4;444; A
   28:      C ;%5;555; A
   29:      C ;%6;666; A
   30:      C ;%7;777; A
   31:      C ;%8;888; A
   32:      C ;%9;999; A
   33:      M,* *[!#]= =
   34:      C ;111;%1; A
   35:      C ;222;%2; A
   36:      C ;333;%3; A
   37:      C ;444;%4; A
   38:      C ;555;%5; A
   39:      C ;666;%6; A
   40:      C ;777;%7; A
   41:      C ;888;%8; A
   42:      C ;999;%9; A
```

Figure 1C1. The editor procedures.

```
N*OPER.RIME

.  (WRITTEN BY N.J. DAVISON)
.  USED TO PREPARE TEXTS FOR WORD-COUNTING, PHONE ISOLATION
.  OR RHYME SEARCHS AND SUCH.  IT ELIMINATES PUNCTUATION MARKS
.  AND IS NORMALLY USED ONLY AS A SUB-ROUTINE.
.  8/8/77
    6:      T
    7:      ON BR
    8:      C,* /://  G
    9:      C,* /,//  G
   10:      C,* /;//  G
   11:      C,* /.//  G
   12:      C,* /!//  G
   13:      C,* /?//  G
   14:      C,* /--/ / G
   15:      C,* /(//  G
   16:      C,* /)//  G
   17:      C,* /[//  G
   18:      C,* /]//  G
   19:      OFF BR
```

Figure 1C2. The editor procedures.

```
EDIT <29A> 12/05/80 21:15 FOUR(17):F
EDIT
*>CALL N*OPER.CON/M1  END*BEGIN

  153:      OR SAY THAT THE END PRECEDES THE BEGINNING

 NOT THAT ONLY BUT THE CO-EXISTENCE
 OR SAY THAT THE END PRECEDES THE BEGINNING
 AND THE END AND THE BEGINNING WERE ALWAYS THERE

  154:      AND THE END AND THE BEGINNING WERE ALWAYS THERE

 OR SAY THAT THE END PRECEDES THE BEGINNING
 AND THE END AND THE BEGINNING WERE ALWAYS THERE
 BEFORE THE BEINNING AND AFTER THE END

  403:      OF THE PETREL AND THE POROPOISE.  IN MY END IS MY BEGINNING

 THE WAVE CRY THE WIND CRY THE VAST WATERS
 OF THE PETREL AND THE POROPOISE.  IN MY END IS MY BEGINNING
III 1  I DO NOT KNOW MUCH ABOUT GODS BUT I THINK THAT THE RIVER

  873:      AND TO MAKE AN END IS TO MAKE A BEGINNING

IV 5  WHAT WE CALL THE BEGINNING IS OFTEN THE END
 AND TO MAKE AN END IS TO MAKE A BEGINNING
 THE END IS WHERE WE START FROM AND EVERY PHRASE

  882:      EVERY PHRASE.  AND EVERY SENTENCE IS AN END AND A BEGINNING

 THE COMPLETE CONSORT DANCING TOGETHER)
 EVERY PHRASE.  AND EVERY SENTENCE IS AN END AND A BEGINNING
 EVERY POEM AN EPITAPH AND ANY ACTION
```

Figure 2A. Locating identical elements separated by other words.

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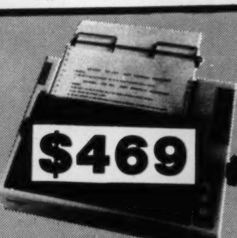

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Commonality of Theme

The final example I'd like to offer is a program designed to locate several elements related by a commonality of theme or meaning, much as the context searches just described, and convert the data into a graphic statement, a kind of thematic mapping of the text. The process is carried out by two separate operations. One program is used to locate the desired elements—up to eight are possible—and counts them. The output is captured in an output file which is then processed by a second macro which in turn produces a simulated graph of the profile of occurrences per ten-line interval. The entire process is a bit complex and relies on some hand editing to make the appropriate transformation of the material. The programs also draw upon other simple routines while carrying out their tasks. I suspect that these would have to be broken up into separate operations to be successfully transferred to a small computer.

The sample in Figure 3 shows a configuration of the narrative and thematic elements that establish the internal structure of a medieval tale—later used by Shakespeare for his "Taming of the Shrew." The beginning of the tale, the graph, and the macros are listed there. (In order to save space I chose a very short narration for the example. The program is, of course, more useful on longer pieces.)

The graph enables the user to see at a glance where the thematic densities are greatest. The basic purpose of such graphing is merely to index areas of the text that might most profitably be explored further. They may suggest, for example, the temporal evolution of theme or other items.

* * *

```
N*OPER.CON/M1

.   (WRITTEN BY N.J. DAVISON)
.   SEARCHES STRINGS OR PHRASES WHOSE IDENTICAL ELEMENTS MAY
.   BE SEPARATED BY DISSIMILAR MATERIAL, THAT IS
.   TO SAY THAT THE INTERVENING MATERIAL IS "MASKED".
.   ONLY ONE ARGUMENT IS USED; THE SYNTAX FOR THE "CALL"
.   STATEMENT IS:   N*OPER.CON/M1 BIRD*HAND  .  THE FINDER IS  M  AND
.   THE ARGUMENT IS GLOBAL.  THE LINE CONTAINING THE
.   SEARCHED STRING IS PRINTED WITH ITS LINE-NUMBER.  THIS IS
.   FOLLOWED BY TWO BLANK LINES AND THEN THREE UNNUMBERED LINES
.   OF TEXT.  THESE THREE LINES INCLUDE THE LINE PRECEDING THE
.   SEARCHED LINE, THE SEARCHED LINE, AND THE LINE FOLLOWING.
.   THIS ENABLES THE RESEARCHER TO EXAMINE THE SEARCHED LINE
.   IN CONTEXT.  USE READ-ONLY MODE (EDIT,Z).  11/30/76
     14:       ON BR
     15:       T
     16:       DIS ' '
     17:       LAB:VNM *%*
     18:       DIS ' '
     19:       TEST EOF=0
     20:       JUMP 0
     21:       U
     22:       P 3
     23:       DIS ' '
     24:       DIS ' '
     25:       U
     26:       TEST EOF=0
     27:       JUMP OUT
     28:       JUMP LAB
     29:       OUT:OFF BR
```

Figure 2B. The program.

```
@EDIT N*DEMO.STORY

                    ABOUT WHAT HAPPENED TO A YOUNG
                      MAN WHO MARRIED A VERY
                       WILD AND FIERCE WIFE

                                BY
                          DON JUAN MANUEL

        MANY YEARS AGO THERE LIVED IN A CERTAIN VILLAGE A MOOR

                               [ETC.]
```

Figure 3A. The beginning of the tale.

```
@Edit N*DEMO.BRAVA
  Word-set <    cat dog horse wife obey fetch water hands
             Number of occurrences per 10 lines
------------------------------------------------------------------------
  10: 0
  20: 0
  30: 0
  40: 0
  50: ##############################################################>11
  60: #################################>6
  70: #######################################>7
  80: #############################################>8
  90: #################################>6
 100: #############################################>8
 110: 0
 120: 0
 130: #########>2
------------------------------------------------------------------------
```

Figure 3B. The density graph-or "profile."

```
N*OPER.PREGRAPH

.   (WRITTEN BY N. J. DAVISON)
.   THIS PROCEDURE SCANS TEXTS OF MODERATE LENGTH (UP TO
.   500 OR SO LINES) COUNTING UP TO EIGHT ELEMENTS AND
.   GIVING THE AGGREGATE FOR EVERY TEN LINES OF TEXT.
.   THE RESULT OF THIS OPERATION MUST BE CAPTURED IN A
.   "HELD" FILE SINCE THE DATA MUST IN TURN BE FORMATTED
.   BY ANOTHER PROGRAM--  N*OPER.ULTG  [SERIES]-- TO PRODUCE
.   A GRAPH SUITABLE FOR VISUAL INTERPRETATION.  THE
.   PURPOSE OF THIS SET OF PROGRAMS IS TO ENABLE THE
.   RESEARCHER TO PRODUCE DISTRIBUTION CHARTS ON VARIOUS
.   "WORD-SETS"  THAT ARE SELECTED FOR THEIR THEMATIC,
.   SYNTATIC, OR OTHER COMMON FEATURES.
.     NINE ARGUMENTS ARE USED:  THE FIRST IS THE NUMBER OF
.   LINES TO BE SCANNED (THIS NUMBER MUST BE ROUNDED OFF
.   TO THE NEAREST TEN--SEE N*OPER.TFILL  FOR THIS
.   PREPARATORY OPERATION).  ARGUMENTS TWO THROUGH NINE
.   ARE THE EIGHT ELEMENTS WHICH MAKE UP THE "WORD-SET"
.   DESIRED.  IF LESS THAN EIGHT ARE NEEDED, DUMMIES
.   (E.G. "XX") MUST BE USED.  IF TWO OR LESS ARE WANTED
.   N*OPER.PREGRAPH2  SHOULD BE USED.  IF THE OUTPUT IS
.   TO BE CAPTURED BY USING "@SUSPEND" THE FOLLOWING
.   SEQUENCE IS TO BE USED:
.     @SUSPEND FILE.
.     @EDIT,L FILENAME.ELEMENT
.     CA N*OPER.PREGRAPH 460 HOMBR CHICO MUCHACHO (ETC.)
.     @RESUME
.                ---------------? HOLD
.     @EDIT,O FILE.,NEWFILE.ELEMENT
.     C,1 /FILENAME.ELEMENT/ELEMENT[IN UPPER CASE]/
.     C /[THE ELEMENTS]/[TO LOWERCASE]/
.     CA N*OPER.CLEARTG
.     EXIT
.     @EDIT
.     CA N*OPER.ULTG12       [THIS IN TURN PRINTS THE GRAPH].
.   10/11/78
     36:       ON BR
     37:       LET B=0
     38:       LET A=0
     39:       VW 1 10
     40:       LET C=10
     41:       DO:CA N*OPER.C8GRAPH %2 %3 %4 %5 %6 %7 %8 %9 %1
     42:       LET A=0
     43:       VW 1+C 10+C
     44:       LET C=C+10
     45:       TEST C=%1+10
     46:       JUMP DO
     47:       DIS ' '
     48:       DIS ' '
     49:       ABORT
```

Figure 3C1. The set of theme-graphing procedures.

```
N*OPER.TFILL

.   (WRITTEN BY NED J. DAVISON)
.   USED TO PREPARE TEXTS FOR FIRST STEP OF GRAPH-GENERATION
.   WITH  N*OPER.PREGRAPH .  TAKES ONE ARGUMENT WHICH IS
.   THE NUMBER OF LINES TO BE ADDED TO THE TEXT IN ORDER TO
.   ROUND OFF THE TOTAL NUMBER OF LINES TO AN EVEN 10 (E.G.
.   114 TO 120).  THE SYNTAX IS: CALL N*OPER.TFILL 6 .
.   8/12/78
      8:       ON BR
      9:       LA
     10:       LET A=1
     11:       TAB #
     12:       GO:I #
     13:       LET A=A+1
     14:       TEST A=%1+11
     15:       JUMP GO
```

Figure 3C2.

* * *

Literature, continued...

The few operations I've shown here have been chosen from a library of some thirty editor programs—several of which are suitable for Spanish texts only—that permit a person interested in literary form to look at a number of other aspects as well: the isolation of end-rhymes, internal sound-patterning, frequencies of occurrence of given elements, metrical scanning, key-word searching of bibliographic materials, and so on. But what is of special interest are the implications of some of these programs in terms of software for small computers, and, more important, the suggestion that text editors lend themselves so naturally to the study of literature that their increased flexibility and versatility should be aggressively pursued.

Expansion of text editor capabilities could be very productive indeed if their ease of use could be enhanced. Although I am not trained in the sciences nor in programming, it would seem to me that it might not be an especially difficult task to make text editors easier to use for those of us unfamiliar with electronics and computing in general. I believe humanists will be more interested in computers when the languages have been adapted for unspecialized users, when they have been made less intimidating. Also, as small computers become more powerful and their programming simpler and more accessible to the uninitiated, the analytical uses can be made more subtle and imaginative. The diversification of applications might increase rapidly as more and more individuals, whose interests are literature and language, are brought into the new technology. The entrance of new expertise should be very productive indeed.

It is important to emphasize also that such analytical programs can be easily adapted to teaching. They can be used to produce graphic material, printouts for distribution, and aids of all sorts that may serve in very traditional ways in the classroom. Or they might also be modified for tutorial programs, where the student, in a controlled environment, would be able to explore diction, versification, and other aspects of textual composition. The experimentation could be fruitful as a learning experience and would likely lead to new analytical concepts as well.

I think it is important that those with knowledge of computers and gifted in programming make every effort to implement the "virtuality" Ted Nelson speaks of in his plea for systems devised with the user, especially the uninitiated user, in mind ("Interactive Systems and Virtuality," *Creative Computing*, November and December 1980).

There is a remarkable array of creative talent and humanistic expertise in the world that could offer a great deal if the computer can be made a bit more accessible. ☐

```
N*OPER.C8GRAPH

.  (WRITTEN BY N. J. DAVISON)
.  THIS IS USED ONLY AS A SUB-PROCEDURE OF "PREGRAPH".
.  TOTALS THE EIGHT ELEMENTS GIVEN AS ARGUMENTS 2 THRU 8
.  AND DISPLAYS THE TOTAL AGGREGATE COUNT PER TEN
.  LINES OF TEXT.  IT DESTROYS THE FILE SO IT IS
.  AUTOMATICALLY ABORTED BY THE MASTER PRECEDURE N*OPER.PREGRAPH.
.  12/12/78
           T
           ON BR
           LAB1:C /%1// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB1
           T
           LAB2:C /%2// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB2
           T
           LAB3:C /%3// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB3
           T
           LAB4:C /%4// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB4
           T
           LAB5:C /%5// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB5
           T
           LAB6:C /%6// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB6
           T
           LAB7:C /%7// N
           LET A=CHG+A
           TEST EOF=0
           JUMP $+2
           JUMP LAB7
           T
           LAB8:C /%8// N
           LET A=CHG+A
           TEST EOF=0
           JUMP DIS
           JUMP LAB8
           DIS:DIS '  ' C ':   ' A
```

Figure 3C3.

```
N*OPER.CLEARTG

.  (Written by N. J. Davison)
.  Takes the "held" file produced by N*OPER.PREGRAPH and
.  cleans it up, making it suitable for formatting
.  with the ULTG series of graphing procedures.
.  No arguments are used.  10/10/78
           ON BR
           c,l /@EDIT,L/@Edit/
           L CA
           MAS &
           C /&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&/  Word-set <
           CA N*OPER.DELETE END
           CA N*OPER.DELETE DATA
           CA N*OPER.DELETE @RE
           CA N*OPER.DELETE EOF
           CA N*OPER.DELETE EDIT
           C /XX// A
           U 3
           D *
```

Figure 3C4.

```
N*OPER.ULTG12

.  (Written by Ned J. Davison)
.  This procedure is used to format, into the configuration
.  of a graph, the output of the pregraphing macros for
.  establishing density distribution of strings (word-families,
.  word fragments, or individual phones).  See PREGRAPH series
.  for a sample of the way in which this procedure is used.
.  The "#" is used as the symbol for separating numbers from
.  the base.  Used for frequencies of 12 occurrences or less.
.  1/31/79
           ON BR
           MAS &
           C,* /:/:  /
           C,* /  &&:/   &&:/
           C,* /     0/0/
           C,* /     10/################################################>10/
           C,* /     11/#####################################################>11/
           C,* /     12/##########################################################>12/
           C,* /     1/###>1/
           C,* /     2/########>2/
           C,* /     3/#############>3/
           C,* /     4/##################>4/
           C,* /     5/#######################>5/
           C,* /     6/############################>6/
           C,* /     7/#################################>7/
           C,* /     8/######################################>8/
           C,* /     9/###########################################>9/
           DIS ' '
           DIS ' '
           DIS ' '
           V1 @
           DIS ' '
           VL,* <
           LS 0:
           DIS ' '
           DIS '          Number of occurrences per 10 lines'
           DIS ' '
           DIS ' ----------------------------------------------------------------------'
           DIS ' '
           P *
           DIS ' ----------------------------------------------------------------------'
           DIS ' '
           DIS ' '
```

Figure 3C5.

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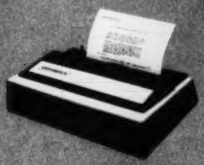

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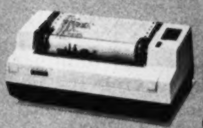

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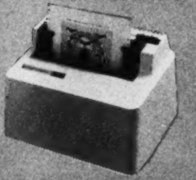

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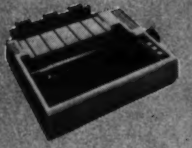

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The Problem Solver

David Ahl

Long time readers of *Creative Computing* will recall that in January 1976, I put together an all games and puzzles issue. It was quite popular being one of the two issues that were ever reprinted (the other was on artificial intelligence). In the issue was a 15-page section of over 100 puzzles, many suitable for computer solution. (These puzzles may be found today in *The Best of Creative Computing, Volume 2* for $8.95—advt.).

In any event, many of the puzzles were reprinted or adapted from *Games & Puzzles*, at the time a monthly British magazine. For as long as I can remember the puzzle column was compiled by the incredibly talented David Wells. However, as magazines are wont to do, *G & P* underwent some changes and the May 1977 issue was the last in which David Wells put together the puzzle column. P.R. Jackson took over but, alas, lasted only until May/June 1978. About that time Graeme Levin sold the magazine to Willow House Press who, some months later, in turn sold it to AHC Publications.

G & P has now split into two bi-monthly magazines, *The Gamer* and *Top Puzzles*. For subscription rates, write AHC Publications, 23A George Street, Luton, Beds, England. American readers, however, might find *Games* more to their liking.

But what, you may ask, happened to David Wells? That's what I wondered too. In late 1979, I saw a small announcement from Dover of a new book, *Recreations in Logic*, by D.G. Wells. I bought it immediately and had a delightful time with the 63 puzzles therein. At $1.75 (plus $.70 shipping), the book is a steal from Dover Publications, 180 Varick St., New York, NY 10014. But it got me no closer to finding David.

Well, a note from David last week says he is doing well with his new company, London Game Consultants, 194 Goldhurst Terrace, London NW6, England. Among other things he is publishing a once-a-term 16-page booklet, *The Problem Solver* aimed at students and people interested in recreational puzzles. He doesn't mention the cost, but you can write the publisher, Rain Publications, 6 Carmarthen Road, Westbury-on-Trym, Bristol, England for further details. Send something for stamps—this is a low-budget operation!

All this was a rather long-winded way of introducing some new puzzles by David Wells.

4 Problems

1. There is only one number, apart from 1, which divides exactly into each of these numbers. What is it?

163231
152057
135749

2. Many numbers can be written as the difference of two perfect squares. For example:

$$5=9-4 \quad 20=36-16 \quad 21=25-4$$

Which numbers *cannot* be written as the difference of two perfect squares?

3. What is the sum of the following series if "carried on forever"?

$$1 - 1/2 + 1/4 - 1/8 + 1/16 - 1/32 + \ldots$$

4. A quadrilateral has sides of length 5 cm, 5 cm, 1 cm and 7cm, in that order. What is its maximum possible area?

The Problem Solver contains an additional 48 puzzles and, like the problems here, no solutions! Have fun! ☐

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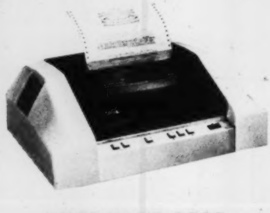

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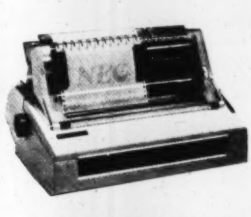

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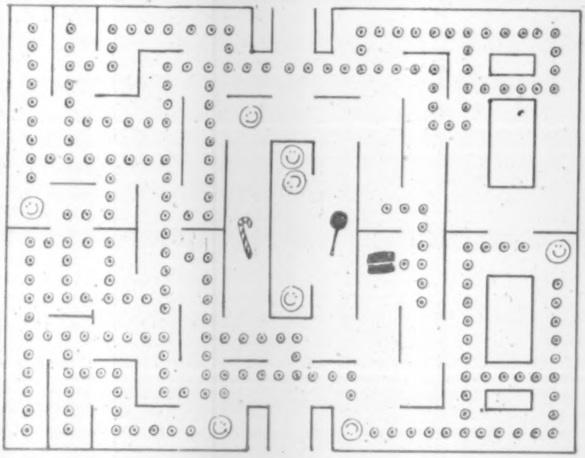

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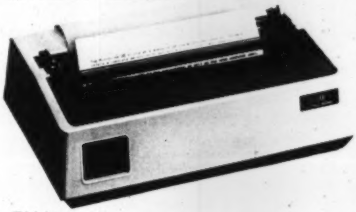

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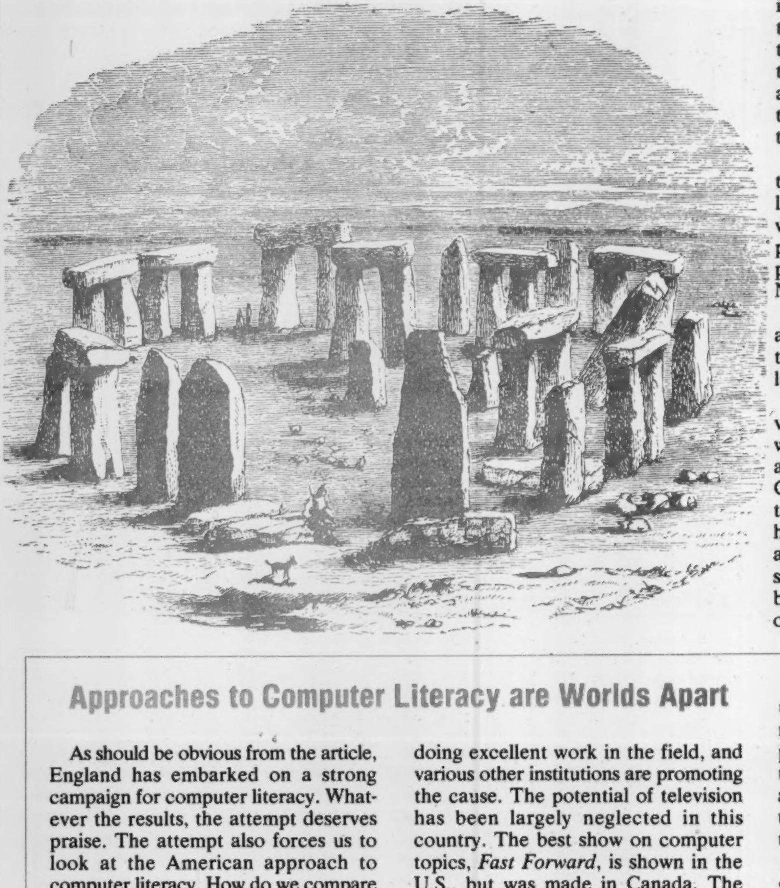

The British Broadcasting Corporation is about to launch a major new project in the field of computer literacy. The aim of the project is to introduce interested adults to the world of computers and computing, and to provide the opportunity for viewers to learn through direct experience how to program and use a microcomputer.

The project is built around a ten-part television series, and includes a book, a linked microcomputer system complete with user guide, a range of applications programs, and an associated course in programming in Basic provided by the National Extension College.

It will follow on from *The Silicon Factor*, a series about the impact of microelectronics on society, which was first shown last year.

The project consists of three series about various aspects of the computer field. There will be a course aimed at teachers who are interested in computers and computing. Called *Technology for teachers*, it aims to answer any question a teacher might have and focuses in particular on the advantages and disadvantages to the student. Another course for people in business and industry will provide examples of how computers have been and can be

Approaches to Computer Literacy are Worlds Apart

As should be obvious from the article, England has embarked on a strong campaign for computer literacy. Whatever the results, the attempt deserves praise. The attempt also forces us to look at the American approach to computer literacy. How do we compare with England and the rest of the world?

Unfortunately, the American approach, like the unicorn, seems to be something that doesn't exist. There is no unified effort to introduce people to computers. Individual examples come to mind, scattered bright spots where good work is being done. MECC is doing excellent work in the field, and various other institutions are promoting the cause. The potential of television has been largely neglected in this country. The best show on computer topics, *Fast Forward*, is shown in the U.S., but was made in Canada. The lag time is so great that New York stations are currently showing episodes that are several years old. For example, we just saw an episode announcing that the latest breakthrough in the industry was the use of very-large-scale integration. And *Fast Forward* is not shown nationally. It is independently scheduled by individual public stations.

Computerworld, the only other regular TV show is produced by the weekly newspaper of the same name. The newspaper is oriented to the EDP side of the industry and most of the TV shows aired to date reflect this bias. Nevertheless, it's a step in the right direction.

Thanks to computer courses in schools, the next generation stands a better chance of being computer literates. But this does nothing for those already out of school. A vast segment of the adult population still views computers as huge constructs of flashing lights and tape reels, capable of little more than generating form letters and incorrect bills. England has begun their massive campaign. Why can't we?—DL both used and misused in industry and the office. Both courses will examine the moral and social problems created by the use of microprocessors.

By far the most extensive course, however, will be *Hands on Micros*. This course will consist of ten television programs and is designed to introduce fundamental ideas and provide viewers with experience with computers and programming. In conjunction with the course, the BBC will provide a handbook and a very versatile, expandable and affordable computer. Other services provided will be a 30-hour self-teaching course on Basic programming offered through the National Extension College, and a service to provide tutorial help with any problems that may arise.

The series will start in January 1982 and will be repeated later in the year. It is hoped that it will provide the layman with an insight into computers and computing at several levels: a basic level, just from watching the programs; an intermediate level, from reading the handbook and watching the series; and finally, an advanced level from buying and using the BBC microcomputer.

The computer is a potentially very advanced unit. In its simplest form, it will consist of a 6502 microprocessor, 16K of RAM and 32K of ROM consisting of a 16K Basic and a 16K operating system. Interfaces for cassette, disk, video, printer, Teletext and Prestel will either come as standard or be available as expansion options. The enhanced version of the computer wil be available with 32K of RAM, analog-digital interfaces, RS232 interface and an IEEE bus connector.

> ***This is an extremely ambitious undertaking by the BBC and if it generates enough interest among the public, could make Britain the most computer literate nation in the world.***

The computer has various graphics modes ranging from the 80 x 25 text character mode, to 640 x 256 high resolution graphics in two colors. Lower resolutions can have up to eight colors. Many other expansion capabilities will become available, including networking and time sharing with other systems. The initial cost of the computer alone will be approximately $480.

This is an extremely ambitious undertaking by the BBC and if it generates enough interest among the public, could make Britain the most computer literate nation in the world. For many people, it will be their first exposure to computing. At present, computing in Britain is limited to the professional programmer who works for ICL, IBM or other such companies, and to the hacker, who may be as sophisticated as his American counterpart, or could be using a long-outdated, mysterious set of circuit boards.

The personal computer revolution has arrived in Britain, but it has not proceeded as far as it has in America. The average Briton still thinks of a computer as a large box covered with whirring reels of tape. Some know better; some don't.

At worst, the BBC's venture will open the eyes of a few more people and lead them into the wonderful world of computing. At best it could revolutionize the attitudes of a nation. □

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The DS-65 Digisector® opens up a whole new world for your Apple II. Your computer can now be a part of the action, taking pictures to amuse your friends, watching your house while you're away, taking computer portraits . . . the applications abound! The DS-65 is a random access video digitizer. It converts a TV camera's output into digital information your computer can process. The DS-65 features:

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Use the DS-65 for precision security systems; computer portraiture; robotics; fast to slow scan conversion; moving target indicators; reading UPC codes, musical scores and paper tape and more! **GIVE YOUR APPLE THE GIFT OF SIGHT!** DS-65 Price: $349.95 / FSII Camera Price: $299.00 / Combination Price: $599.00

ADDITIONAL SOFTWARE FOR THE DS-65

—**Picture Scanner:** Provides a variety of different dithering algorithms for compressing the digitized image into the Hi-Res screen. Available on 13-sector disk. Price: $39.95

—**Superscan:** Enables you to enhance the DS-65's Hi-Res pictures with colors! Choose from 21 different colors and assign them to grey scale values, modify pictures, zoom, enhance contrast, etc. Print routines for the Anadex and Paper Tiger* are provided. Comes on a 13-sector disk. Written for The Micro Works by Magna Soft. Price: $79.95

—**Portrait System Software:** This program includes captions and a credit line, reverse printing for T-shirt application and the option to save portraits on disk. Specifically for use with a Malibu 165 printer. Call or write for more information.

*Paper Tiger is a trademark of Integral Data Systems, Inc.

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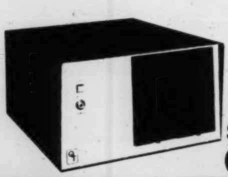
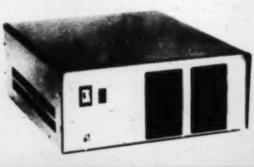


SYSTEM+ (8")



MINI-SYSTEM+ (5¼")

QT SYSTEM +

The QT System+ is designed for both businessmen and engineers in accordance with the latest IEEE standards. Among other functions, it can be used for accounting and word processing, as well as a variety of scientific applications. The system will soon be available with MP/M® to allow multiuser, multi-tasking operations. This means, for example, that an engineer could be working on scientific applications in the lab while an accountant is writing payroll checks in the office. QT also offers a full line of business and applications software, ranging from a business package to word processing.

Technical specifications: 4MHz Z-80A CPU • Dbl-sided, dbl-den. 5¼" & 8" floppy disk controller (handles both drives simultaneously) • Two 8" dbl-den., sgl. or dual sided disk drives, expandable to 4 floppy drives • CP/M® 2.2 included • 64K RAM • Comes complete in single mainframe • EPROM/ROM in any combination to 8K • Two RS232C serial I/O ports • Two parallel I/O parts • Hard disk compatible • Real time clock • Std. 2K monitor program & disk routines included on ROM • Power-on/Reset jump to monitor program • 2716 (5V) EPROM programmer (software incl. on monitor ROM)(ext. 25.5V @ 50ma req.) • Uses Z-80A CPU vectored interrupts • Assembled, tested & burned • Documentation included.

With Terminal 920C Add $900.00

SYSTEM + I (1MB+)

SYS+SS Computer System with 8" Single Sided Drives (801R) without Terminal

A&T (6 slot)	**$3595.00**
A&T (8 slot)	**$3695.00**
A&T (12 slot)	**$3795.00**

SYSTEM + II (2MB+)

SYS+DS Computer System with 8" Dual-Sided Drives (Qume DT-8) without Terminal

A&T (6 slot)	**$4495.00**
A&T (8 slot)	**$4595.00**
A&T (12 slot)	**$4695.00**

MINI-SYSTEM + I (½MB+)

Computer System with 5¼" Single Sided Drives (uses B-51 Disk Drives) No Terminal

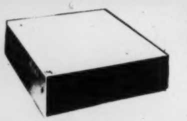
A&T (6 slot)	**$2495.00**
A&T (8 slot)	**$2595.00**
A&T (12 slot)	**$2695.00**

MINI-SYSTEM + II (1MB+)

Computer System with 5¼" Double Sided Drives (uses B-52 Disk Drives) No Terminal

A&T (6 slot)	**$2795.00**
A&T (8 slot)	**$2895.00**
A&T (12 slot)	**$2995.00**

DISK DRIVE PRODUCTS



QT DISK PACKAGES

DDC-88-1	Dbl Den Controller, A&T, two 8" dbl den drives (801R) CP/M® 2.2 cabinet, power supply & cables	**SPECIAL $1495.00**
DDC-88-2	Two 801R disk drives with cabinet, power supply, fan & cables	**$1200.00**
DDC-88-22	Two DT-8 Qume drives with cabinet, power supply, fan & cables	**$1600.00**
DDC-88-3	Cabinet with power supply, fans & cables	**$ 275.00**
DDC-88-4	Cabinet only	**$ 75.00**

DISK DRIVES

8"

Shugart 801R Sgl/Sided Dbl/Den	**$ 450.00**
Qume Datatrak 8" Dbl/Den QME-8DS (851R)compatible	**$ 650.00**
Pkg of two	**$1250.00**

5¼"

MPI-B51 MPI B-51 Sgl Sided Sgl/Dbl Den	**$ 235.00**
MPI-B52 MPI B-52 Sgl Sided, Dbl Den	**$350.00**
MPI-B91 MPI B-91 Sgl Sided, Dbl Den, 77 tracks	**$ 375.00**
Shugart SA400 SHU-SA400 Sgl Sided, Dbl/Den	**$ 250.00**

S-100 PRODUCTS

Double Density - Cal Comp Sys
5¼" or 8" disk controller with free CP/M 2.2

CCS-2422A A&T	**$374.95**

Expando RAM II - SD Systems
4 MHz RAM board expandable from 16K to 256K

SDS-RAM216K 16K kit	**$289.95**
SDS-RAM216AT 16K A&T	**$339.95**
SDS-RAM232K 32K kit	**$329.95**
SDS-RAM232AT 32K A&T	**$379.95**
SDS-RAM248K 48K kit	**$369.95**
SDS-RAM248AT 48K A&T	**$419.95**
SDS-RAM264K 64K kit	**$409.95**
SDS-RAM264K 64K A&T	**$459.95**

PROM-100 - SD Systems
2708, 2716, 2732, 2758 & 2516 EPROM programmer

SDS-PROM-100K kit	**$220.00**
SDS-PROM-100AT A&T	**$275.00**

ITHACA AUDIO REV 2.0 Z-80 BD

Bare Board	**$35.00 each**

10 for $300.00

SEALS ELECTRONICS 32K STATIC BD

Uses TMS-4044 or 5257L	**$35.00 each**

QT MEMORY EXPANSION KITS

TRS-80 • APPLE • EXIDY

4116 200 ns	**8 for $32.00**
2716 (5V-450 ns)	**$ 9.00**
2716 (5 & 12V-450 ns)	**$ 9.00**
2732 (5V)	**$40.00**
2114L 300 ns	**8 for $36.00**

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8080A	**$ 3.50**
8085A	**$20.00**
8086-4	**$60.00**
8088	**$60.00**
8748	**$60.00**
TMS 9900 JL	**$29.95**

8080A SUPPORT

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8214	**$ 4.50**
8216	**$ 2.95**
8224	**$ 4.00**
8228	**$ 6.00**
8238	**$ 6.00**
8243	**$ 5.00**
8251	**$ 7.00**
8253	**$19.00**
8253-5	**$20.25**
8255	**$ 6.25**
8257	**$17.95**
8257-5	**$19.00**
8259	**$19.95**
8275	**$69.95**
8279	**$17.50**
8279-5	**$18.00**
8295	**$16.50**

KEYBOARD CHIPS

AY5-2376	**$13.75**
AY5-3600	**$13.75**

BAUD RATE GENERATORS

MC14411	**$11.00**
1.8432 XTAL	**$ 4.95**

DISK CONTROLLER

1771B01	**$24.95**
1791B01(CER)	**$37.95**

EPROMS

1702A	**$ 4.95**
2708	**$ 6.25**
2516 (5V)	**$ 9.00**
2716 (5V)	**$ 9.00**
2716 (5 & 12V)	**$ 9.00**
2758	**$19.95**
2532	**$40.00**
2732	**$40.00**

USRT

S2350	**$ 7.95**

MISCELLANEOUS OTHER COMPONENTS

N8T20	**$ 3.25**
N8T26	**$ 2.50**
N8T97	**$ 2.00**
N8T98	**$ 2.00**
1488	**$ 1.25**
1489	**$ 1.25**
D3205	**$ 3.00**
D3242	**$14.00**
P3404	**$ 6.75**
TMS5501	**$19.00**
DM8131	**$ 3.00**

UARTS

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AY5-1013A	**$ 4.50**

CHARACTER GENERATORS

2513 UP CASE (5&12V)	**$10.95**
2513 LWR CASE (5&12V)	**$10.95**
2513 UP CASE (5V)	**$ 9.75**
2513 LWR CASE (5V)	**$10.95**

6800 PRODUCTS

6802P	**$18.00**
6821P	**$ 5.25**
6840P	**$18.25**
6845P	**$22.00**
6850P	**$ 4.80**
6860P	**$11.55**
6875P	**$ 7.40**

QT PRODUCTS

SBC+2/4 SINGLE BOARD COMPUTER

Features: 1K RAM (which can be located at any 1K boundary) plus one each Parallel and Serial I/O parts on board • Power on jump to on-board EPROM (2708 or 2716) • EPROM addressable on any 1K or 2K boundary • Full 64K use of RAM allowed in shadow mode • Programmable Baud rate selection, 110-9600 • 2 or 4MHz switch selectable • DMA capability allows MWRT signal generation on CPU board or elsewhere in system under DMA logic or front panel control • Two programmable timers available for use by programs run with the SBC+2/4 (timer output and controls available at parallel I/O connector; parallel input and output ports available for use on CPU board).

Bare Board	$ 60.00
Kit	$190.00
A&T	$295.00

Z+80 CPU

Features: Power on jump to on-board EPROM (2708, 2716 or 2732) • EPROM addressed on any 1K or 2K boundary; also shadow mode allows full 64K use of RAM • On-board USART for Synchronous or Asynchronous RS-232 Operation (Serial I/O port) • Programmable Baud rate selection, 110-9600 • Switch selectable 2 or 4 MHz • MWRITE signal generated if used without front panel • Front panel compatible.

Bare Board	$ 50.00
Kit	$150.00
A&T	$210.00

RAM+16

Features: S-100, 16K x 8 bit static RAM • 2 or 4 MHz • Uses 2114 1K x 4 static RAM chip • 4K step addressable • 1K increment memory protection, from bottom board address up or top down • Deactivates up to six 1K board segments to create "holes" for other devices • DIP switch selectable wait states • Phantom line DIP switch • Eight bank select lines expandable to ½ million byte system • Data, address and control lines all input buffered • Ignores I/O commands at board address.

Bare Board	$ 35.00
4Mhz Kit	$190.00
4Mhz A&T	$225.00

RAM+ 65

•S-100, 16K x 8 bit static RAM •2 or 4MHz •Uses 2114L (300NS) CHIP •Addressable in 4K steps •Memory protection in 1K increments, from bottom board address up or top down • May deactivate up to six 1K segments of board to create "holes" for other devices • DIP switch selectable wait states • Phantom line DIP switch •Features bank selection by I/O instruction using any one of 256 DIP switch-selectable codes—allows up to 256 software-controlled memory banks.

Bare Board	$ 35.00
4MHz Kit	$210.00
4MHz A&T	$250.00

EXPANDABLE+ REV II DYNAMIC MEMORY BOARD

NEW

Features: Runs at 4MHz • 3242 refresh controller with delay line • Four layer PC board insures quiet operation • Supports 16K, 32K, 48K or 64K of memory • 24 IEEE-specified address lines • Optional M1 wait state allows error free operation with faster processors • Optional Phantom disable • Uses Z-80 or on-board refresh signal • Bank on/off signal selected by industry standard I/O port 40 (Hex) • Convenient DIP switch selection of data bus bits determines bank in use • 3 watts low power consumption • Convenient LED indication of bank in use.

Definitely works with Cromemco and North Star

Bare Board .... $ 75.00

KIT		A&T	
No RAM	$230.00	16K	$350.00
16K	$280.00	32K	$450.00
32K	$360.00	48K	$575.00
48K	$480.00	64K	$675.00
64K	$525.00		

CLOCK/CALENDAR+ FOR APPLE II, S-100 OR TRS-80

Features: Date/Month/Year • Day of week • 24 hour time or 12 hour (a.m./p.m.) selectable • Leap year (perpetual calendar) • 4 interval interrupt timer; 1024Hz (approx. 1 millisec), 1 sec., 1 min., 1 hr. • On-board battery backup • Simple time and date setting • Simple software interface • Time advance protection while reading.

Battery Included

S-100 or Apple		TRS-80	
A&T	$150.00	A&T Only	$150.00
Kit	$100.00		
Bare Bd.	$ 60.00		

WATCH FOR THE FOLLOWING NEW BDS:

- **4 Port Serial Bd (APR)**
- **E-PROM Programmer (MAY)**
- **Floppy Disk Controller (JUN)**
- **Hard Disk Controller (JUN)**
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Has two serial Sync/Async ports (RS-232, current loop or TTL) with individual Xtal controlled programmable baudrate generators • Four 8-bit Parallel ports; one latched input port and other three can be programmed in combinations of input, output or bidirectional • Also, has three 16-bit Programmable Timers and an 8-level Programmable Interrupt Controller w/Auto restart (8080 / Z80) • Other features include; on-board clock divisor for timers, completely socketed, wire wrap posts for easy port configuration plus more.

Bare Board	$ 70.00
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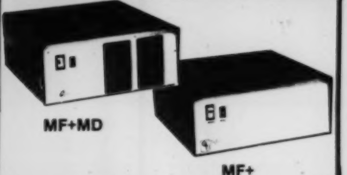
6 Slot		12 Slot	
Bare Board	$ 25.00	Bare Board	$ 30.00
Kit	$ 40.00	Kit	$ 70.00
A&T	$ 50.00	A&T	$ 90.00
8 Slot		**18 Slot**	
Bare Board	$ 27.00	Bare Board	$ 50.00
Kit	$ 55.00	Kit	$100.00
A&T	$ 70.00	A&T	$140.00

QT MAINFRAMES



5¼" Disk Mainframe with 25A Pwr Sup

MF+MD12 (12 slot M/B)	$500.00
MF+MD8 (8 slot M/B)	$475.00
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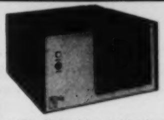
Q.T. Mainframe

MF+12 (12 slot M/B)	$450.00
MF+18 (18 slot M/B)	$500.00
MF+22 (22 slot M/B)	$600.00

MAINFRAME+ DISK DRIVE



Includes cabinet, 25 amp power supply, IEEE S-100 compatible 6, 8 or 12 slot motherboard and dual 8" disk drive with disk drive power supply.

MF+DD6	$625.00
MF+DD8	$650.00
MF+DD12	$675.00

DDC-8 SINGLE 8" DISK CABINET

Accepts one 8" disk drive (Shugart, Remex, PerSci, Siemens, etc.) • Fan cooled, with data cable and AC line filter to eliminate EMI • Operates from 100-125VAC/200-250VAC at 50-60Hz • Disk drive NOT included.

DDC+8	$195.00

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bridging the gaps

Karl L. Zinn
and
Bernard Banet

Improving the links between national resources and local services, spanning gaps between development and applications, between product design and use, between educational marketing and learning effectiveness—these were the goals we set for ourselves.

The project we were to design using funds provided by the program for Development in Science Education of The National Science Foundation was intended to improve the effectiveness of microcomputers in education. Since we had spent some time working with schools and colleges on planning activities, inservice training, and problem solving, we were especially concerned with the contribution of local resource people in the use of technology in teaching. We had also been involved in various national resource networks, and appreciated the significant contributions of information centers, development projects, vendors, and publishers to the introduction of new ideas.

The result of our efforts is the Dataspan project, and is intended to help bridge the gaps between existing networks and groups. (For anyone who cares about acronyms, "Dataspan" can be expanded into "decision aids for technological assistance with science programs aided by networks.")

A key function of national and regional centers is to demonstrate, document, and disseminate procedures and materials designed to reach individuals on a person-to-person basis. But the intended recipients have not been plugged into the flow of information about microcomputer applications in education: some are first-time computer users; others are familiar with larger computer systems but don't know about microcomputers. We wanted to encourage distribution of the best available resource materials and examples of software from all sources. And we wanted to get it directly to the groups, individuals, and institutions that are being asked for advice and assistance on the selection and use of computer systems in science education.

In this network the flow of information is rapid so that confirmation of facts and validation of new ideas follow quickly.

Furthermore, we discovered something that we now feel is more important even than the availability of helpful materials: effective use of computers depends on local resource people, user communities, and, perhaps, service centers, through which new ideas are reviewed, shared, and put into practice.

Local Resources

People seeking to use advanced technology in education appear to prefer hands-on demonstrations of equipment and information centers. Such local, knowledgeable experts are being sought from among computer professionals, educators, media specialists, retailers, and the staffs of libraries and science museums.

Dataspan will encourage a variety of sources to provide objective and conveniently organized materials with which to provide such assistance efficiently. Local resource people and institutions will find advice on assisting people in decisions regarding educational computing—dealing with the rapid change and complex tradeoffs among cost, capability, reliability, maintenance and availability of applications.

Teachers, parents, administrators, and students face a perplexing and rapidly changing world of hardware and software. An unfamiliar jargon describes the features of various systems. Millions of people will be buying computers for the first time in the next five years; they will need help in selecting wisely if the potential of these systems for science education is to be realized. They will need to turn for advice

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*Funded in part by a grant from the National Science Foundation to High/Scope Educational Research Foundation. The ideas expressed are those of the authors, and do not represent policy of NSF or the U.S. Government.

Bernard Banet, High/Scope Foundation, 600 N. River St., Ypsilanti, MI 48197.

Karl L. Zinn, U-M CRLT, 109 E. Madison St., Ann Arbor, MI 48104.

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ALF 3 Voice Music Card	239
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Alpha Syntauri Keyboard System	1399
Corvus 10 MB Hard Disk	CALL
Lazer Lower Case Plus	50
Micro-Sci Disk Drives (A40 & A70)	CALL
SSM AIO Serial/Parallel Card A&T	189
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Supertalker SD-200	239
Romplus + Card	135
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CCA Data Management	85
DB Master	169
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Desktop Plan II	169
Applewriter	65
Easywriter	225
Appleplot	60
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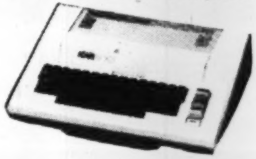
VisiTerm	129
VisiTrend/VisiPlot	219
DOS Toolkit	65
Dow Jones Portfolio Evaluator	45
Dow Jones News & Quotes Reporter	85
Apple Fortran	165

Atari Personal Computer



ATARI 800 16K $749

Atari Accessories

410 Program Recorder	59
810 Disk Drive	449
850 Interface Module	159
16K Ram Memory Module	89

Please call us for an Atari Software List.

S-100 Cards

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I04 2 P + 2 S I/O	189	249
VB-3 80 × 24 VIDEO	329	379
VB-3 80 × 48 VIDEO	369	429
BV-2 VIDEO	159	219
PB1 PROM PRGMMR & EPROM BOARD	139	199
CCS		
Z80 CPU 2810	n/a	229
64K Dynamic RAM card	n/a	499
16K Static RAM 2 MHz	n/a	249
16K Static RAM 4 MHz	n/a	269
Dbl. Density Floppy Disc Controller	n/a	299
12 Slot S-100 Mainframe	n/a	349

Apple II Plus Computer

16K	48K
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Disk drive w/out controller 439

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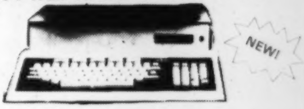

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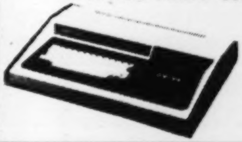

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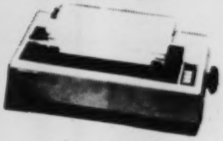

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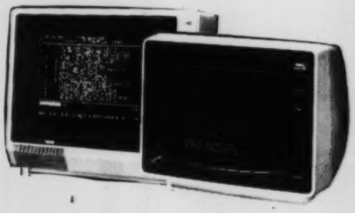

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CIRCLE 140 ON READER SERVICE CARD

to sources other than just the hardware manufacturers and product salesmen. They will need assistance in locating and using the software that is available, and in making practical plans to supplement this with local development efforts. Perhaps the largest obstacle to effective use of these systems for learning is no longer the cost, or even the lack of applications programs, but rather the lack of objective, expert guidance in first selecting and then making effective use of a given hardware system or program.

Meeting the Challenge

Our discussions with Dataspan advisors and colleagues delivering similar services throughout the country led us to tentative solutions to the following seven problems or challenges:

1) Keeping up with the changing technology and market conditions. The project staff, consultants, and advisors are part of a network of people working with computers in science teaching. In this network the flow of information is rapid so that confirmation of facts and validation of new ideas follow quickly. Some of the local service people can be brought into this network, especially through activities of professional associations. The products provided will aid in establishing the links among users and with resource people. Furthermore, the products are designed to be readily updated, not only by staff of some national resource center working through successive revisions, but by local service centers making local adaptations and carrying on after the Dataspan project no longer provides updates. From the start we are selecting information and drafting guidelines which apply to a range of technology and applications. For example, salient characteristics of equipment and essential considerations in selection of applications will survive several generations of microcomputers.

2) Identifying those functions of computers which are particularly useful in science education. Published comparisons of microcomputers tend to represent only superficial characteristics and those that can be easily measured in a casual review. Using expert judgment and analysis of published reviews of products, applications, and trends, Dataspan will derive a set of essential functions which serve the purposes of science education. For example, it is not computation speed but responsiveness to users (in a learning exercise or problem situation) which is important. The size of a character set is not as important as the ability to define new characters, or select among predefined character sets that have been designed for use in the sciences.

3) Encouraging and facilitating review of hardware, software, and applications by experts and experienced users within each discipline. The Dataspan project does not propose to judge products for use in science teaching, but to increase the quality and availability of information. The information files carry published and unpublished information, presented in a way that encourages users to extend the files with additional information and opinions. From a variety of sources, advice and commentary on diverse applications, software, and hardware will be distributed to practitioners and decision makers in science education. Some of the unpublished information will be assessed by users, and its credibility further established through informal reviews. Indeed, some of the better material will probably be published. The informal network we encourage will continue to relate to the formal network of publications.

Dataspan will help local centers share files of useful information, and explore ways in which continuing exchange among centers can be self-maintaining.

4) Adapting the materials to different audiences and situations. The workshop materials, indeed all of the products, will be annotated by staff and consultants. A subset of materials will provide a "starter set" for local staff lacking experience with microcomputers or ideas about sound applications. The full set of Dataspan tools can be used with various audiences by the more experienced local staff. The services provided will use computer-based files which can be changed by local experts and by additions from other projects, professional associations, publishers, vendors, and other sources, so that the local staff is backed up by considerably more than the limited resources of the Dataspan project. The cooperative effort which we encourage is likely to stimulate additional publishing, by professional associations as well as commercial sources, through which additional materials, reviews, guides and surveys will be distributed widely.

5) Exploiting electronic communication aids to increase benefits at low cost. The project will make available community bulletin board and conferencing systems which can help with local communications among resource people and users. Already some of these systems have proved helpful for peer consultation, usually within a computer club or similar setting. The cost of such microcomputer-based systems is decreasing so that many resource centers will be able to dedicate a system with sufficient memory to the purpose. Dataspan will help local centers share files of useful information, and explore ways in which continuing exchange among centers can be self-maintaining. Electronic communications are also proposed for moving information quickly among development projects, consultants, advisors, and test sites for rapid, efficient communication. In our experience much more consultation and planning can be accomplished in computer-based conferencing than in successive telephone calls with each individual participant in a group activity.

6) Capturing an adequate number of applications programs. Dataspan is cooperating with several national projects in collecting examples of good software, and summarizing the larger catalogues of vendors, distributors, clearinghouses, and projects which list what has been offered for sale or swap. Two years ago we collected public domain software written for a popular microcomputer which a local store had given away to many educators. A casual effort brought in over 100 items for the Commodore PET, about 70 of them for math and science education. Of course, many of these programs are useful only as a starting point for a better program that needs to be written or to generate new ideas about computer use and teaching. The important point is to start the information flowing and review possible applications.

We view Dataspan as a catalyst for various processes by which materials are generated and shared. A modest quantity of quality materials readily available will help many science educators avoid mistakes which otherwise add up to a considerable cost in dollars spent, development time expended, and learning lost.

7) Relating to the ongoing system of science education. The impact of the outcomes of this project can be characterized by scenarios which illustrate ways in which the products and systems serve real needs in science education.

A fifth grade teacher uses decision aids and exemplary materials found in the school district's instructional materials center to locate activities suitable for the students' first experiences with the school's new microcomputers.

A junior high school social studies teacher venturing beyond the textbook finds programs to illustrate a discussion of the statistical principles behind public opinion polling by using a resource file in the county library.

A district science coordinator gets information about local expertise on computer languages by using a "community bulletin board" system which the local computer club has selected and installed.

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CIRCLE 111 ON READER SERVICE CARD

A community college math instructor finds programs for plotting equations by using resource files at the college computing center.

Parents use an interactive decision aid in a science museum to help them decide whether to buy a microcomputer for their daughter to nurture an interest in science.

A district superintendent resolves a conflict between requests from the math and science coordinators by using an interactive decision aid program on hardware selection.

A group of high school physics teachers requests information about the feasibility of extending standard text material with illustrations of optical principles (using their microcomputer) by using decision aids and resource files on authoring, and on hardware and software selection.

Survey of Information Resources

A telephone survey of information providers throughout the country was undertaken to sharpen the definition of Dataspan's mission as a facilitator of what others are doing, and to minimize redundant efforts. This survey convinced us we should give more attention to describing the major national efforts which now provide educators with information about computer applications.

From our survey we have identified four clusters of needs and opportunities: exchange among providers, additional resources, new means of communication to end users, and focus on local resource centers.

1) Information providers with activities that are national in scope can benefit from more exchange of information. In many cases one activity can build on another, and can publicize another. Already the Dataspan staff has served as an "electronic circuit rider" using phone and computer communications, passing word of resources and plans from one provider to another. The distribution of the materials to the information providers named there should bring additional people on the circuit.

2) The information providers we surveyed felt they lacked the resources to acquire, organize and distribute information and software products on the scale needed to keep up with the rapidly expanding volume of publications, computer software, and computer hardware components. One step toward a solution would be a more consistent Federal role in assigning tasks to federally funded clearinghouses and dissemination projects, or perhaps an increase in the centralization of educational information and dissemination services. Another part of the solution seems to be emerging now in support given users by hardware vendors, software publishers, and distributors.

3) The technology and the literature describing it are changing so fast that traditional publication mechanisms can't transmit information fast enough. New technologies offer part of the solution, but few educators will seek out information using electronic retrieval systems, unless these systems require very little effort. Those educators already using computers in some way are better able to access computer networks and databases than their colleagues who do not already use systems.

4) The local actions necessary to extend and improve the use of computers in science education depend on local resource people and facilities. However important it may be to increase coordination of information services nationally (through the leadership of projects like Dataspan, direct Federal initiatives, and efforts of the commercial sector) we also need to give careful attention to the linkage between these national resource networks and the local service centers. How is it that local people come to know about the various services? And how do the providers keep in touch with the needs of local centers throughout the country? We intend to make a difference in what is happening throughout the country for each local information provider in libraries, media centers, curriculum centers and offices, educational service agencies (such as Intermediate School Districts in Michigan and Boards of Cooperative Educational Services in New York), state departments of education, and so on.

Education at the precollege level in the United States encourages local information seeking and dissemination as part of the treasured autonomy of school districts, school buildings, and individual teachers. In this process the enormous amount of redundant effort appears inadequate or incomplete when compared to the magnitude of the task (for example, developing instructional software, reviewing the literature on computer applications, previewing instructional software, or acquiring optimal system configurations).

A Call for Help

We expect to have our first draft of a resource package into field test sites for the opening of school in the fall of 1981, and commentary on the role of national networks published in the educational newsletters and bulletins. By the summer of 1982 we will have helped put in place the mechanisms which will keep the information flowing from national resource nets to local centers and back.

Obviously we need help. We are looking for information and advice about orientation, inservice training, system selection, software and materials review, planning, development, funding, community bulletin board systems, small computer information management systems, and any other aids to improving the use of computers in schools. Join us! ☐

PLATO: Alive and Well?

David H. Ahl

At $5 million plus, it was the most expensive computer education project ever funded by the National Science Foundation. The NSF bowed out in 1975 with a flurry of optimistic memos and reports that projected the widespread use of the system by 1980.

Control Data Corp. was convinced and took over PLATO two years later. Their subsequent investment makes the NSF look like pikers. But where is PLATO today? Certainly not in all the colleges and secondary schools forecast by the NSF.

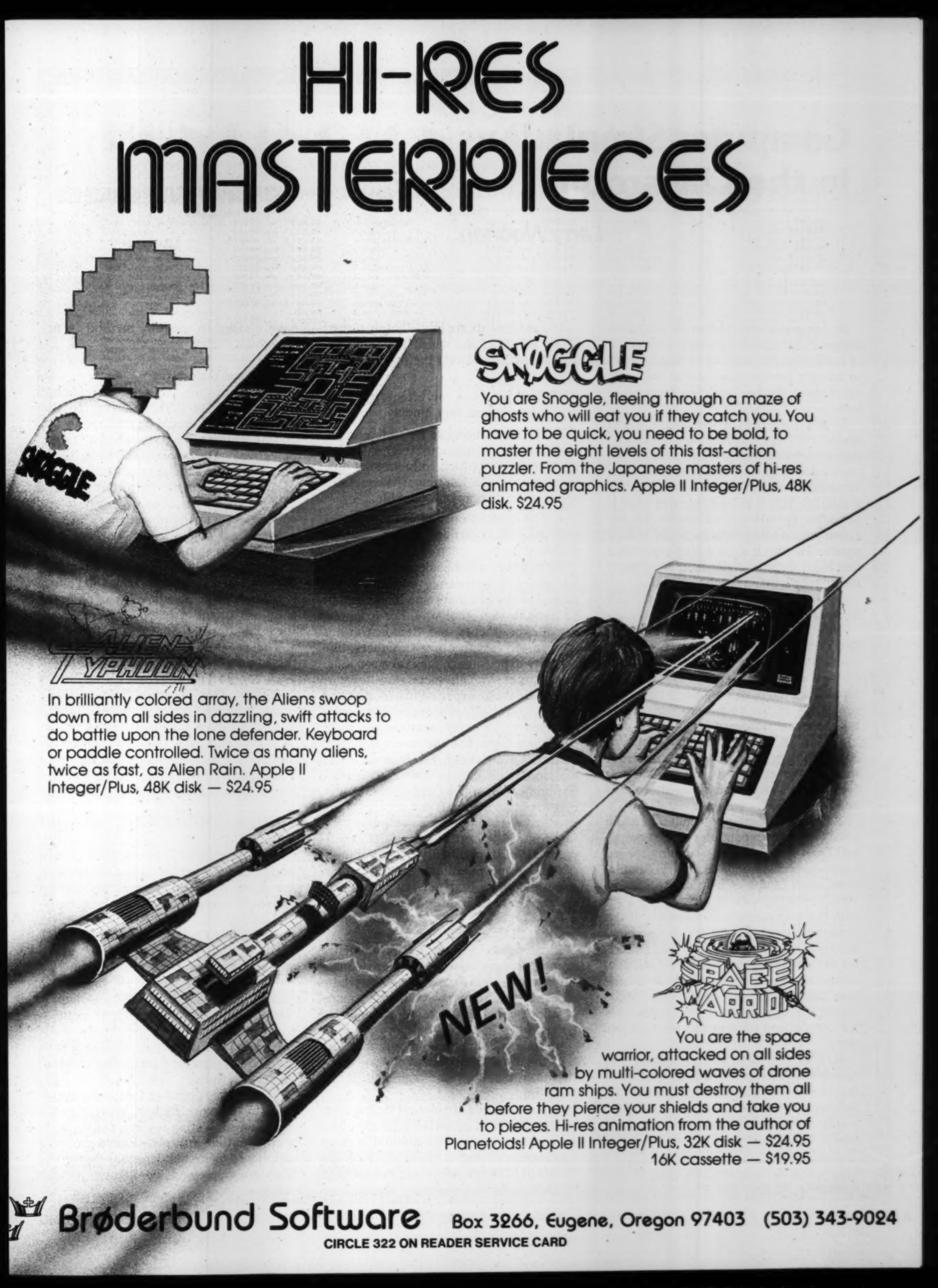
After much ballyhooing about the system, attending educational conferences and courting influential educators, CDC apparently learned the same lesson as every other company in the education market. The lesson: educators are not innovators. Not only that, but educators expect the software to be free. Creative Computing Software recently received a petition from a group of educators protesting that the MECC software is on "protected format" disks. They wanted to buy one set of disks and copy them for all the schools in a county. Perhaps this notion that software should be free springs from the fact that books are filled with sentences, pictures and diagrams (software) rather than being blank. But I digress.

CDC wisely retreated from the traditional school market and focused on instructional programs for business and industry. One of their first major sales ($3 million) in 1977 was to American Airlines. They use the Plato system to replace some instruction previously done on a much-more costly flight simulator.

Other systems have been sold to brokerage firms to train stock brokers. Since 1977, CDC has developed approximately 7000 course modules in scores of subject areas and expects their staff of 500 course designers to produce another 2000 programs in 1981.

CDC doesn't publish separate financial results for the Plato operation but confirms that sales of courseware topped $100 million in 1980. Nevertheless, it's still a losing venture from a profit standpoint. But not one likely to be dropped any time soon. In fact, Thomas W. Miller, CDC's vice president for education said, "Our plans clearly are to expand the base of activity in Plato, not to cut it back." And William Norris, CEO of CDC expects that some day more than half of CDC's revenues and profits will be derived from Plato.

We'll see. ☐



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Computer Simulations in the Classroom

Larry Noonan

A computer simulation is a system designed to reproduce essential aspects of reality for the purpose of finding ways to manage, control, solve, and/or ultimately agree upon the best solution for a problem.

In the classroom a simulation allows students to make judgments and, ultimately, decisions based on logic, observation and their knowledge of the real world. If the simulation is also a game, as is the computer simulation that I will discuss here, then it becomes an educational game. In the classroom, an educational game can change passive learning into an active experience that helps students understand more easily the concepts being taught.

Some Questions

Why use a computer simulation? This is a very important question. Computer simulations are not meant to replace hands-on activities and experiments, but to supplement them. Before using a computer simulation in the classroom you should ask these questions.

1. Can the simulation that you are considering be done better in a different way? If the answer to this question is "yes" then you should use that alternative and forget about computer simulation.

2. Does the computer simulation make good use of the capabilities of the computer? Does it use graphics, simplify record keeping, eliminate unnecessary calculations, etc.? Graphics help the student to visualize the experiment and simulate work with real equipment and materials. If the student or teacher must do all the calculations and keep all the results and records for the experiment or demonstration, then it might be better to do the whole simulation using paper and pencil only. Some record keeping may, however, be desirable for comparison purposes as we shall see later.

If, after you have answered these two questions, you feel that a computer simulation is what you want, consider the following four reasons that I often use to justify my use of this particular teaching tool.

1. The students are immediately turned on to this machine which has a certain amount of control over their future in the game.

2. The feedback or effects of their decisions are seen very quickly.

3. The simulation can be more complicated in its calculations (e.g. sales tax influences jobs which influence income tax, etc.) while keeping the outward appearance as simple as possible.

4. The random portion of the game or simulation is controlled by an unbiased machine.

Other reasons that computer simulations are enjoying increasing popularity are related to the fact that some things cannot be done in any other way. For example, some experiments and demonstrations happen too fast to observe. Others, like heredity experiments, may take too long. A computer simulation can slow down or speed up these experiments so that the results and the processes are easily observed. Some experiments such as those involving high voltage or radioactive materials are too dangerous to do in the classroom but can be safely simulated. Experiments involving expensive or difficult-to-obtain materials and apparatus can usually be simulated on a computer for a fraction of the cost of the actual experiment. Some experiments are too complicated. A computer can simplify these experiments so that only the important concepts and their interactions are seen.

Sources of Computer Simulations

Most software distributors advertise computer simulations. Some are educational but most are classified as entertainment. There are two ways in which many of these can be adapted for the classroom.

1. Make a commercial program fit into the classroom situation and develop activities and objectives that happen to fit that program.

2. Try to find a simulation that accomplishes the educational objectives which you wish to teach. This method is often more difficult but it is, in my opinion, better to fit the simulation to the needs of the class than vice versa. Therefore, I have chosen to use this method in my classroom.

Educational Objectives

There are two kinds of educational objectives. The first, referring to the knowledge that should be attained by the end of the simulation, is called a "target objective." The second refers to those skills which are acquired during the course of simulation because they are necessary to meet the target objectives. These are called the "enabling objectives."

My target objective for the computer simulation was: to have the student, given a series of simulated real life situations, recognize and identify the cause and effect relationships involved by trying different solutions to the problems presented by the computer.

The program that I chose to achieve this objective is *Santa Paravia and Fiumaccio* for the TRS-80 Level II from Instant Software. This program has very little documentation, none of which refers to educational uses. It allows teams or groups of students to participate simultaneously and keeps records for up to six groups.

The game crowns a ruler whose objective is to accumulate land, grain and tax money and to construct buildings in his city while keeping his subjects alive and, presumably, happy.

The objectives in the program correspond with my target objective because the game requires the problem solving and intellectual skills of identifying cause and effect relationships. It also involves the cognitive strategy of originating solutions to such problems as what to do when bad weather strikes and how to balance revenues with grain production to keep the people healthy and happy. The students must try different methods to solve these and other problems, study the results and then apply what they have learned to create new and better solutions to the problems.

My enabling objective for this simulation was: to have the student, given a group situation simulating society, demonstrate a co-operative attitude within a group by helping to make the decisions that would lead to successful completion of the game.

Larry Noonan, 787 Strouds Lane, Pickering, Ontario, Canada.

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Simulations, continued...

This objective requires students to work in a group for the common good of the group. Without co-operation within the group, failure to complete the game successfully is all but certain. It was hoped that each student in the group would see co-operation as an essential means to the desired end.

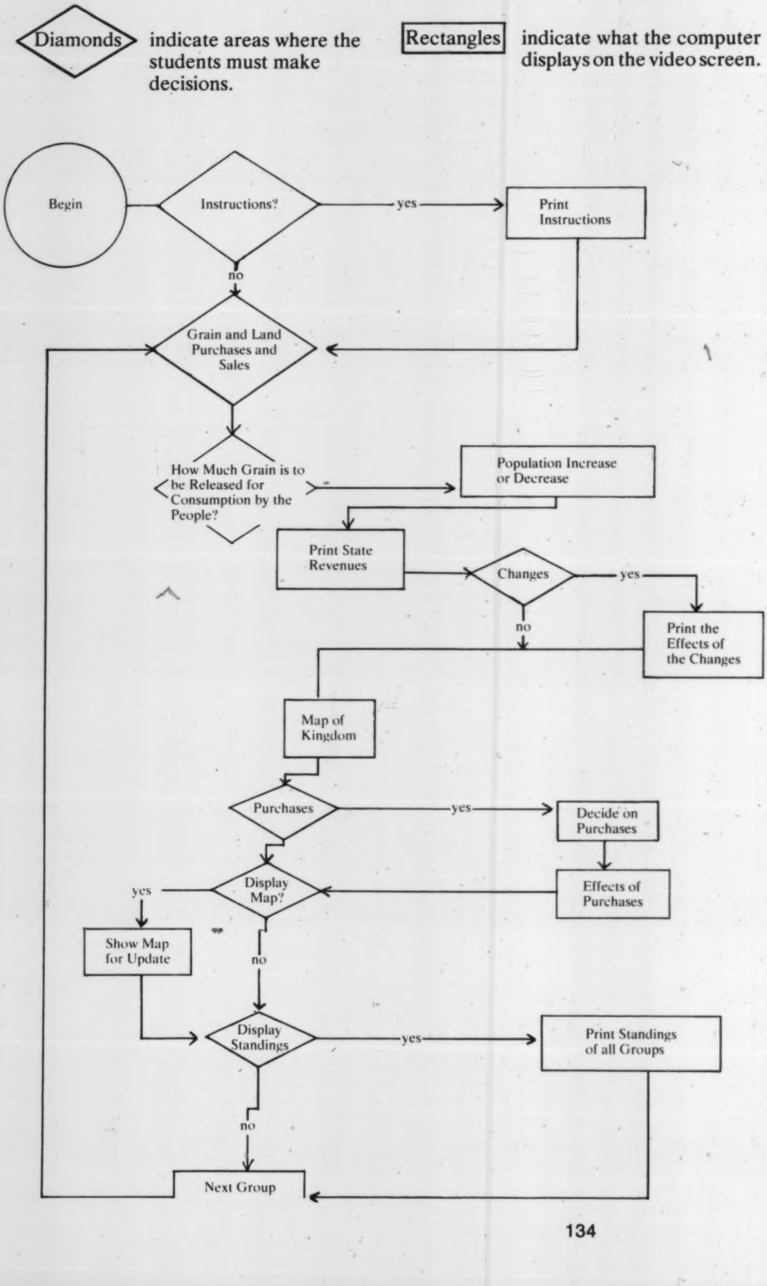
Intellectual skills required to calculate the best way to proceed and practice in decision making are also among the enabling objectives.

To use this simulation the students must have certain skills. They are:

- Computational skills of addition, subtraction, multiplication and division
- The ability to read with understanding
- The motor skills of drawing straight and curved lines
- The ability to write
- Mapping skills

Figure 1 shows a flow chart of the simulation.

Figure 1. Flow Chart.


Diamonds
indicate areas where the students must make decisions.
Rectangles
indicate what the computer displays on the video screen.
Begin
Instructions?
yes
Print Instructions
no
Grain and Land Purchases and Sales
How Much Grain is to be Released for Consumption by the People?
Population Increase or Decrease
Print State Revenues
Changes
yes
no
Print the Effects of the Changes
Map of Kingdom
Purchases
yes
Decide on Purchases
Effects of Purchases
Display Map?
yes
Show Map for Update
no
Display Standings
yes
Print Standings of all Groups
no
Next Group

Using a flow chart allows the teacher to examine and understand the program and devise worksheets for the students.

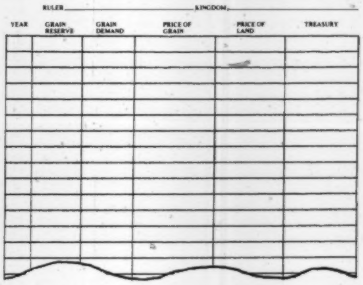
Worksheets

As a permanent record for the students and the teacher, it is a wise idea to develop worksheets that will be filled in during the running of the program. As already mentioned, these worksheets should not require a large number of calculations. To draw up the worksheets, examine the simulation and find all the areas where the computer reports results or observations.

I developed worksheets in the following areas.

1. *Grain and Land* (See Figure 2.) The groups must decide to sell or buy grain on the basis of crop yield for that year, the price of grain and the amount needed to feed the people. Selling grain helps the treasury to buy markets and factories to make more money and create jobs. If too much is sold, however, there may not be enough to feed the people, and starvation will result. Fewer people means fewer tax payers which means less money for the treasury. Land can be purchased on which to grow more grain or it can be sold for cash.

Figure 2. Grain and Land.



RULER ______________ KINGDOM ______________

YEAR	GRAIN RESERVE	GRAIN DEMAND	PRICE OF GRAIN	PRICE OF LAND	TREASURY

2. *State Revenues* (See Figure 3.) The taxes and duties can be increased or lowered affecting the economy of the nation. For example, if the sales tax is raised, fewer products are purchased and fewer people are required to produce the products. As a result, the total income tax is decreased. (All of the complicated calculations are done by the computer.)

3. *Standings* (See Figure 4.) This sheet allows the groups to study the progress of other groups, compare their own performance and decide where they need to improve. It helps them to decide on strategy.

4. *Map* (See Figure 5.) This map is updated with every turn (every year in the game) and helps the groups to visualize their kingdoms.

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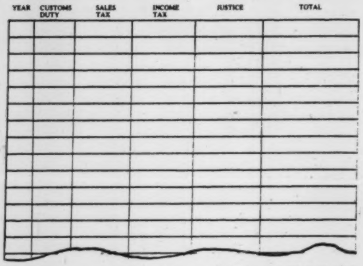
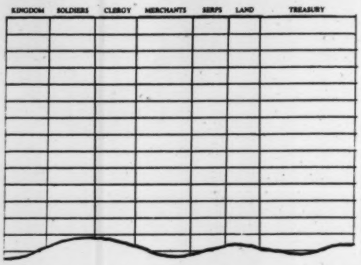
CIRCLE 275 ON READER SERVICE CARD

Figure 3. State Revenue.



YEAR	CUSTOMS DUTY	SALES TAX	INCOME TAX	JUSTICE	TOTAL

Figure 4. Standings.



KINGDOM	SOLDIERS	CLERGY	MERCHANTS	SERFS	LAND	TREASURY

Figure 5. Map.

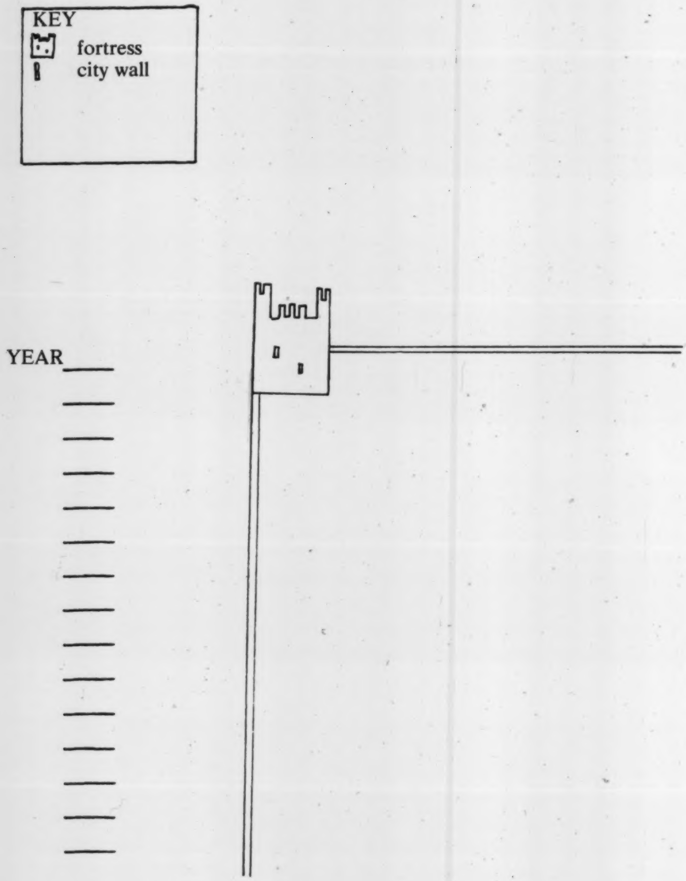


Figure 6. Learner Flow Chart.

1. DECISION - buy or sell land
2. DECISION - buy or sell grain
3. DECISION - amount of grain to give to the people
4. DECISION - raise or lower or keep taxes the same
5. DECISION - build markets, etc. or not build them

Learner Flow Chart

In order to analyze the possible results of a decision a learner flow chart should be drawn and examined. These flow charts can be as simple as the one in Figure 6.

The five decisions that the students make during each turn, all have a cause and effect relationship that the student hopefully will soon recognize and then use in further decisions. Some of the effects are immediate (e.g., if the people receive too little food many of them starve. This, of course is to be avoided.) Other effects take longer to see (e.g., buying land results in the production of more grain during the next year).

Analysis of Learner Flow Chart

1. Decisions are made concerning purchases and sale of land. The students that used this simulation quickly realized that more land meant more crops while less land meant more immediate money. These facts are weighed one against the other and a decision is made. The effect of the decision is apparent during the next turn.

2. A decision must be made concerning the buying or selling of grain. If there is too much grain because of a good crop year then the students usually sell some of it for money that can be used in other areas. If there has been a bad year, I found that the students had more difficulty making a choice to buy or to let some of their people starve. Since the object of the game is to make as many gains as possible, including population, the usual decision was to buy grain. I observed during this process that the majority of students were concerned about keeping as much money as possible in order to buy markets and make more money. There was however, in each group, at least one person who saw the results of giving less food to the people (i.e., starvation). It was this one person or small group within the group that always prevailed. These people, although usually not the dominant players on their teams, used good arguments to convince the rest of the group. I found that good judgment consistently won out over apparent greed. I was surprised to find this.

3. Calculating skills were required to make the decision of how much grain to give to the people. Some grain was needed for the next year. Too little grain given to the people meant immediate death for many, while too much meant that babies would be born and immigration would increase. Too much grain was the usual choice at the beginning of the game until a year of bad weather occurred, the supply of grain was exhausted, and many serfs died. From then on the students took considerably more time in calculating their grain reserves.

Cause and effect relationships were seen

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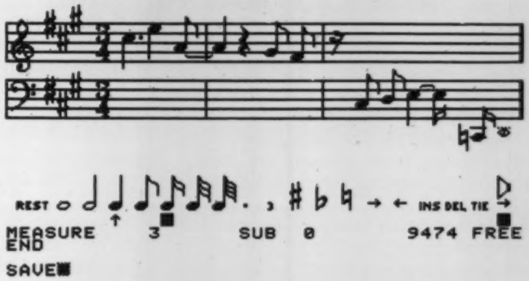

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(Excerpts from unsolicited letters. Copies of original letters available on request.)

About the A L F system:

It's a rare enough occurrence when hardware/software lives up to one's expectations. For something to exceed one's wildest hopes — as the ALF synthesizer certainly does — is a real treat. My congratulations to all concerned.
—Dhahran, Saudi Arabia

I myself have told several people that next to a disk, I consider the [ALF] synthesizer to be the most important peripheral they could purchase for their system. Very excellent job! Keep up the good work.
—Oak Ridge, Tennessee

I recently purchased 2 of your Apple music boards. Out of the peripherals I have for my Apple, I enjoy them the most. It has to be the most enjoyable thing that has ever been invented. I hope you continue to develop products as clever and enjoyable as this one. The Entry program has to be one of the most sophisticated programs I have ever seen. It proves that a hardware manufacturer DOES have the ability to also produce quality software. It is almost worth the price of the boards just for the Entry program.
—Burbank, California

About ease of use:

I have had my Music Card MC1 for a little more than a week now and I have almost completed entering "The Maple Leaf Rag". I found it to be a lot simpler than I thought and so I am very, very pleased. My family isn't because I sit up to all ends of the night playing with the blasted thing!
—Cypress, Texas

ALF has opened up my head and ears and enabled me to do things musically which I would like to be able to do on [conventional] instruments. As much as I love the instruments I try to play, I just don't have the talent and technique to play what is in my head. By golly, the ALF board doesn't know about my limitations, though. I can play hell out of that thing, playing notes and tempos which previously have existed only in my head. Many thanks from a frustrated musician and satisfied ALF "player".
—Demopolis, Alabama

About documentation:

I don't know much about hardware, but I have been a programmer for 15 years and I have never seen a better piece of software documentation than your user manual. It is a joy to study!
—Lancaster, California

About the competition:

Recently, I purchased an [ALF] 9-voice board and a couple of music albums .... all I can say is that I wish I had listened and played with it before I purchased the Mtn. Hardware board. It sounds about the same and is vastly superior in software, ease of use, and price. The Entry program is a joy to use and it's easier than Mtn. Hardware's, but then, I guess you guys know that already. (Oh yes, you wouldn't happen to know of anyone that wants to buy a Mtn. Hardware system? $450 or best offer?)
—Kirkland, Washington

I would like to tell you that after having used the system ONLY ONE DAY, that I am absolutely delighted with it. In addition, I purchased the three boards although I ALREADY own Mountain Hardware's music system. Now that I have seen and own your system, I am putting my "old" one up for sale. I think that your software makes it far easier to enter music, and that the software routines allow for far greater flexibility. Again, I extend my compliments to you. As I said, I have owned another music system, and consider myself therefore, qualified to make a judgement between the use of the two. Yours is the clear choice!
—Levittown, New York

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most easily here as people starved for lack of food or births and immigration increased because of an abundance of food.

Here as in the other decisions, the students evaluated previous decisions and their effects and tried to improve upon them during subsequent turns.

4. Decisions must be made about raising or lowering taxes. Results are, again, immediate, however there are long term effects which are less evident. An example would be that a decrease in sales tax produces immediate loss of revenue but stimulates production and increases jobs so that income tax revenues increase. This second result is not evident until subsequent turns. I found that most students had difficulty recognizing this point.

5. The fifth decision involves the building of markets and mills. To build costs money but creates more jobs and taxes. If the following year has good weather then everything will be fine for those groups that spend all their money on building projects. If bad weather and poor crops come, then money is needed to buy grain or many will starve. It is here where the element of chance comes in.

The students usually took one of the following routes:

1. Gamble on good weather and deplete the treasury to build markets. These groups often made quick gains but rarely ended up in the lead when the game was over.

2. Build fewer markets and mills and keep some money in reserve. The groups that chose this course made slower progress but usually ended up higher than the gambling groups at the conclusion of the game.

Conflicts often arose within the groups as to which way to go. The attitude toward working in a group for the common good of the group is developed during situations like this. If no decision could be agreed on then the leader of the group had the final say. The most important thing for me, as the teacher, to ensure was that the decision (cause) was made and its results (effects) were seen and studied.

Testing Results

When using a computer simulation in the classroom, it is difficult if not impossible to test formally the results of the learning. Instead, the final outcome and observations of the groups form the basis of the testing that must be done. By observing the groups and how they work it becomes clear which groups and which individuals are developing the necessary co-operative attitude which is so essential in the game. Periodic examination of worksheets will also help to determine if the students are learning from their experiences with cause and effect relationships.

If, when the game is over, the group has more money, population, markets, etc. than when it started, it is deemed successful. The degree of success is measured in the final difference between that with which it started and that with which it ended. If, for instance, two groups start out with 1000 people and one ends up with 10,000 while the other ends up with 2000 then the first group understands the cause and effect relationships in the game better than does the second group which could have increased its population by pure luck.

By examining all the areas where gains can be made and realizing that the greater the gains the more likely the group understood the purpose of the game and the more likely that they could recognize and work with cause and effect relationships, you can evaluate each group.

If a group ends up with less than they started with or with only a small gain, then it is likely that cause and effect relationships have not been fully understood.

Introducing the Computer Simulation to the Class

Now that you have chosen the simulation, thought about your educational objectives, developed worksheets and become thoroughly familiar with the computer program itself, how do you introduce it to your students?

The term simulation is heard on TV and in the movies enough so that it can be briefly explained to the students as a game that allows a person to make judgments and decisions based on past experience and their knowledge of the real world. A discussion should follow this definition so that the students really understand what they will be doing.

The students should be divided into groups of up to six and the class arranged so that the groups can sit together from the start. This will hopefully promote the co-operative attitude that is so important to the game.

Each of the worksheets that the groups will be using can be made into overhead projections and these can be used to explain the basic rules of the game.

Using each of the worksheets in turn the teacher can work through the techniques of entering data and making decisions. The possible effects of certain actions could be discussed. Examples:

1. What might happen if you sold almost all of your grain?

2. What might happen if you raised the sales tax to 100% to make an object cost twice its worth?

When the basic rules are understood, each group should select a leader. The leader is then asked to select a person or persons for each of the following positions.

•Department of Agriculture: This person uses the Grain and Land Worksheet.

•Treasurer: This person uses the State Revenue Worksheet.

•Department of Commerce: This person uses the State Revenue Worksheet.

•Department of Lands: This person uses the Grain and Land Worksheet.

Results

When I used this computer simulation in my classes (grades 3 to 7) I observed several things. Here are just a few.

Around the fifth turn I noticed that some groups came to the computer prepared to enter values they had already calculated at their desks. This was a good indication that they were looking at the results of their past decisions and making new choices based on the observed effects.

Each time I ran the simulation, some groups hastily made decisions for their first four or five turns, a practice which caused them to fall behind the other groups. As the game went on I noticed that all of these groups started to make better decisions and better thought-out choices. They were learning from their mistakes.

In every game that was played, at the end of eleven turns not one group was worse off than when it started. All groups were successful. Some, however, were more successful than others. These were the groups that carefully thought out the different possibilities and used their past mistakes and correct decisions to their advantage. ☐

To aid those in search of simulations suitable for schools, the following list contains several companies whose product line includes simulations.

Creative Computing
P.O. Box 789-M
Morristown, NJ 07960

Software includes ecology simulations for the Apple and TRS-80, and MECC software for the Apple.

Conduit
P.O. Box 388
Iowa City, IA 52244

Conduit's line includes chemistry, ecology and physics simulations for TRS-80, PET, and Apple.

Edu-Ware Services, Inc.
2222 Sherman Way, Suite 102
Canoga Park, CA 91303

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Atari
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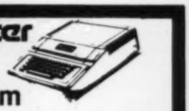

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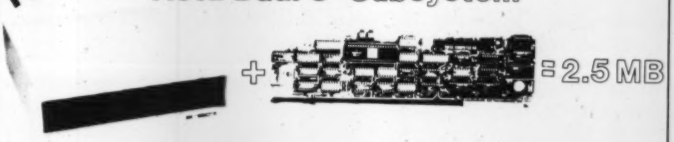

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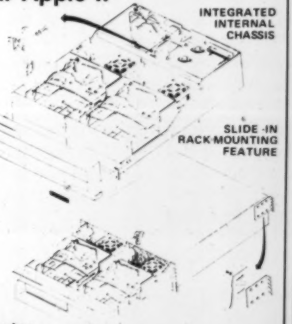

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CIRCLE 146 ON READER SERVICE CARD

How to Solve It — With the Computer

Donald T. Piele

Last Winter an invitation was extended to schools and organizations throughout the United States and the world to participate in our computer problem solving contest. Soon after the announcement appeared in the February 1981 issue of *Creative Computing*, entries began arriving from all parts of the United States, Canada, and a few foreign countries—Great Britain, Australia, Germany, and Ecuador. Within a month, over 500 requests for information were received from groups of all sizes. Some were requests from teachers who had only one team of enthusiastic programmers who wouldn't let them rest until they had entered the contest. Others came from local directors who anticipated having 10 to 20 teams in each division. As the applications began to fill my mail box, I realized for the first time why authors, who encourage their readers to write to them, often request a stamped self-addressed envelope!

Tim Fossum, a colleague at the University of Wisconsin-Parkside, and I had spent two weeks preparing the problems for this year's contest and had checked them out on our individual home systems. On April 4, members of the Parkside Computer Club finished addressing the envelopes and stuffing them with copies of the rules, the contest problems, and the results sheet. Two cardboard boxes filled with 377 overstuffed envelopes were carried down to the campus post office and mailed. The contest was scheduled for Saturday, May 2, 1981.

The Contest

From its inception four years ago, our contest has been entirely interactive. In the two-hour time period, teams of up to three students pit their computer problem solving skills against five problems. Each team has only one computer terminal. Time is the major limiting factor, and, of course, there is never enough of it to do justice to all five problems. It's not that the problems require lengthy programs; in fact, they can each be solved in under 40 lines of Basic code. But to figure them out quickly requires a considerable amount of skill. If our contest were a track event, it would be comparable to the 440 yard run—you've got to go all out from the very beginning, but you must still use some strategy to win.

The Problems

The problems in our contest have become more difficult each year. There is a good reason for this: every year the teams have gotten better. In the local contest last year (our fourth), the winning team in the senior division completed all five problems perfectly! If that could happen locally, imagine what would have happened internationally. Obviously, we would have to dig a little deeper for harder problems this year. We wanted to avoid having to choose a winner based on the number of remark statements used. Unfortunately, more difficult problems make it tough on the rookie teams. (We are looking at alternatives to ease this problem next year.) In any event, here is what we came up with this year—our rookie year for an international event. Figure 1 shows the problems as they were presented to the students. (See pages 146-148.)

The principal of Rockport H.S. presents the Senior Division Trophy to Charles Nicolosi the local contest director. The three students are the members of the winning team. From left to right: Brian Tuck, Jonathan Wise, Chuck Nicolosi (advisor), Dan Lanciani (Captain), Stuart Schnur (Principal).

The Results

Within a few days after the contest was over, the results began to trickle in. After two weeks, we had the results from 64 junior division contests and 92 senior division contests. The number of teams that entered each local contest varied from one to 14 in the junior division (total 226) and from one to 26 in the senior division (total 385). We asked each contest director to give us a breakdown of how many teams solved zero, one, two, three, four or all five problems. The results, shown in Table 1, gave us a measure of difficulty of the contest as a whole in each division.

Number of Correct Programs	Junior Division	Senior Division
0	25%	44%
1	32%	27%
2	20%	16%
3	16%	9%
4	5%	4%
5	2%	0%

Table 1.

Donald T. Piele, Department of Mathematics, University of Wisconsin-Parkside, Kenosha, WI 53141.

It appeared that the senior division contest was more difficult than the junior division contest. Another question of interest was: which problems were solved most frequently? The answer is shown in Table 2.

Problem #	Junior Division	Senior Division
1	39%	35%
2	10%	27%
3	31%	23%
4	11%	12%
5	9%	3%

Table 2.

This provides a clear indication of the level of difficulty of each problem. The 3% who solved the hardest problem in the senior division represents a total of nine teams. Twenty-seven solved problem five in the junior contest.

Finally, we compiled the data on how many problems were solved by the winning teams in the local contests.

Number of Problems Solved by the best local team.	Junior Division	Senior Division
0	3%	3%
1	15%	24%
2	31%	32%
3	28%	26%
4	11%	15%
5	10%	0%

Table 3.

This breakdown, shown in Table 3, can be used to measure the results of individual teams against the best in all the local contests. It can be used by those who want to see how they rank internationally. The average number of problems solved by the winning team in a local contest was 2.56 in the junior division and 2.25 in the senior division.

Included in our letter to each contest director was a temporary rating system. This was constructed before the contest was run and, thus, before we had any feedback about the difficulty of the problems.

Number of Correct Programs	Rating
1	Fair
2	Good
3	Very Good
4	Excellent
5	Super Colossal

Table 4.

This rating system, shown in Table 4, turned out to be very accurate for the junior division. For the senior division, it should be moved back one step so that one correct solution is "Good." This would make four correct "Super Colossal" and five correct "Unbelievable."

The Winners

In the Junior Division (grades 7-9), the top three finishers came from teams with only one student each. Of the top ten teams, seven were made up of only one student. As one might expect (although we hadn't), in the early years fewer kids get

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Junior Division

Team Name	Team Members	School
1. -----	John Rompel	Piedmont Middle S. Piedmont, CA
2. Bug Exterminator	Ken Shirriff	Prince Charles School Portage La Prairie, Manitoba, Canada
3. Weasel	Craig Cohen	Merrick Ave. J.H.S. Merrick, NY
4. SSMCIS 1	Nicholas Cravotta Calvin Chen	Alfred Nobel J.H.S. Northridge, CA
5. Two Bits	Glenn Tesler Erik Olson	Walter Reed J.H.S. North Hollywood, CA
6. -----	Paul Ketrick	Walter Reed J.H.S. North Hollywood, CA
7. Freshman #1	Eric Brand Dwight Lee Andy Williams	Rolling Meadows H.S. Rolling Meadows, IL
8. Disk Wizard	Steve Barkins	Merrick Ave. J.H.S. Merrick, NY
9. Basic Bungalows	Danny Lucas Raymond Waldrop	Bartlesville, OK
10. Limestone	Chip Doren	Bartonville School Normal, IL

Figure 2.

Senior Division

Team Name	Team Members	School
1. Fruitcakes	Dan Lanciani Brian Tuck Jonathan Wise	Rockport H.S. Rockport, MA
2. The Happy Programmers	Karen Eller Peter Frase Bruce Edwards	Terang H.S. Terang, Victoria Australia
3. Electronic Imbroglio	Washington Taylor Jonathan Mark Ian Taylor	Cambridge Rindge & Latin H.S. Cambridge, MA
4. The JNOSCS INC.	Chap Wappes Warren Jacobson Dwight Ettel	Crosier Seminary Onamia, MN
5. Mark	Mark Riley	El Camino H.S. Woodland Hills, CA
6. Scopus Three	Gerard Neil Danny Davis Ken Ross	Mount Scopus Memorial College, Burwood Victoria, Australia
7. Bad Apples	Brad Shipp Andy Gottlieb Dave Wilmer	Moses Brown School Providence, RI
8. Incandescent Penguins	Fareed Stevenson Steve Robbins	Gomper Secondary Ct. San Diego, CA
9. The Mad Programmer	Steve Friedman	Fair Lawn, H.S. Fair Lawn, NJ
10. -----	Gadi Frieman Adam Brailove Amir Fuhrman	Highland Park H.S. Highland Park, NJ

Figure 3.

their hands on computers and the few who do quickly acquire skills beyond their years. Figure 2 lists the top ten teams.

The winner, John Rompel, is a ninth grader who became interested in computers through a neighbor's TRS-80. He wrote the programs for the contest on his school's computer system and was able to complete all five problems perfectly, supply excellent documentation, and help keep the computer system running for the other students—all within the hour time period!

Mathematics and computers are John's long suit. Last year he finished near the top in the California Mathematics League Algebra Contest. Mrs. Ann Reynolds, a teacher at Piedmont Middle School who directed the local contest, remarked, "John is extraordinary in the field of computers. He has had to be continually encouraged to study other subjects, because he has such a marketable skill in math and computers already!"

We hope that John continues to hit the books as well as the keyboard in high school, college and beyond. He has shown us that he has the potential for making truly original contributions in the field of computer science.

In the senior division, the top three teams were made up of three students each. For tougher problems, it obviously helps to be able to divide the problems among three competent people—taking advantage, perhaps, of different strengths. Figure 3 lists the winners in the Senior Division.

Dan Lanciani, the captain of the winning team, is a junior at Rockport H.S.—a small school of 300 located 35 miles north of Boston. Dan's main interest is solid state physics—he designed and built his own home computer system. Chuck Nicolosi, his advisor, recalls the time when the school's PDP-8 went down and the estimate to fix it was $500. "We didn't have $500 in the budget to spend on it. Dan asked if he could work on it over the weekend. Monday morning, it was up and running and the cost of the repair was 15 cents." Besides maintaining and building computers, Dan also enjoys writing computer programs. In fact, he wrote the scheduling program that is used at Rockport H.S.

Brian Tuck, a graduating senior, is also an outstanding programmer. Nicolosi recalls, "Brian was the first on his block to own a TRS-80. He wrote an excellent program for the French teacher—sort of a French version of hangman/concentration."

Jonathan Wise, the third member of the team, is an excellent mathematics student. "All three have participated in the mathematics competitions sponsored by the Massachusetts Mathematics League," Nocolosi added.

The "Fruitcakes," as they call themselves, used an Apple II and completely solved the first four problems. The programs were straightforward, easy-to-read and well documented. The team was almost finished with the last problem when time ran out—an Excellent and near Super Colossal performance.

The Awards

The Parkside Computer Club awarded a silver trophy to the winning team in each division. This is a traveling trophy and the names of the individual team members were engraved on it. *Creative Computing* awarded individual prizes to the top three teams in each division. The cash value of all the

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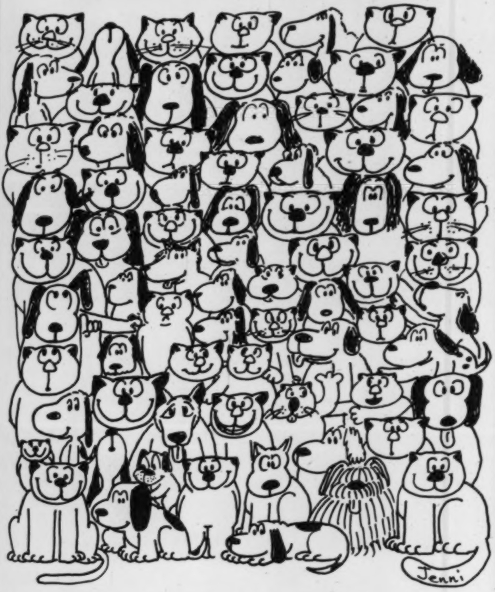

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prizes was kept to a minimum, since we feel that recognition alone is the biggest reward. Certificates of rank were awarded to the top 10 teams.

The Feedback

Throughout the contest, we received letters from people all over the U.S., Canada, and a few other foreign countries. Each day brought another batch of returns which were often accompanied by helpful remarks. We were made aware of difficulties that some local contests had and received several suggestions for improvement in the future. Here is a sample of the feedback:

"Some of the teams with printers felt they were at a disadvantage because of the extra time given those without printers to print out their results after the two hours."

"We look forward to next year's competition. A couple of the problems seemed a bit tough for a two-hour competition."

"It was difficult to interpret "Runs Properly" on some of the problems."

"Please clarify whether partially correct solutions can be given partial credit for creativity, readability, etc." [The rule is: If it does not run correctly, it gets a zero and no partial credit in the other categories.]

"Problem two (Senior Division) can't accept a 70-digit number unless it is a string. However the intermediate digital product becomes too large to compute." [Not if you construct your own string multiplication routine.]

"Too much for three students, one terminal, two hours. But good problems."

"We had problems with one, the easiest, because the students programmed it using PRINT @ which is O.K. for the screen but not O.K. for a hard copy."

We appreciated receiving the feedback, and will use many of the ideas we received to improve the contest for next year. Other comments included:

"Problems were very interesting, but tough! A Challenge! I'm already planning to participate next year."

"This was a great experience for these students. We would like to participate again next year."

"Super problems—great format—kids had a lot of fun."

"An excellent competition and learning experience. Although one of our two teams was completely shut out, all students involved (and many of their friends) are still working on and discussing the problems. This rarely happens (to such a degree) in pure mathematics competitions."

"The 12 students thoroughly enjoyed the challenge, and put in a lot of extra work over the last month. If nothing else they certainly learned a lot about programming."

"Good contest for us. Very hard problems. This was our first time at something like this, but it certainly won't be our last. We all had fun. Thanks for the problems."

The Conclusion

The solutions to this year's problems have deliberately not been included here. Many readers may want to use these problems as exercises for themselves or for a class and we don't want to spoil it. The solutions will appear next month. We will however, send a copy of the solutions to anyone who requests it as long as we receive a self-addressed, stamped envelope (two stamps please). For requests from outside the United States, we will supply the stamps. Please do not send money. The University of Wisconsin—Parkside Computer Club raises enough money each year at our annual computer fair to pay for conducting the international competition. Our biggest time waster is addressing envelopes, and next year it may be even worse. If that job can be eliminated for us, then we can concentrate on keeping the contest alive and interesting.

We enjoy reading all your cards and letters—especially if you don't agree with how we solve the problems. So keep those cards and letters coming, but please include a SASE.

In subsequent columns this year of "How To Solve It—With The Computer," I plan to elaborate on the problem solving skills that were helpful in solving the problems in our First International Problem Solving Contest. Many of the key ideas and techniques that were used by the best teams will be demonstrated. In the course of this series, all of the problems in this year's contest will be solved, and many similar ones will be posed to challenge the reader. An effort will be made to explain the fundamental skills at elementary, intermediate, and advanced levels. This material will be especially useful to those individuals who plan to enter the Second Annual Contest.

The announcement for next year's contest will be made early in 1982. At that time the date will be announced for the 1982 contest, and the newly revised rules will be published. The basic format of the contest will remain the same, but we will try to fine tune it, taking into account the suggestions that we have received from those who competed in the 1981 contest. Here are a few changes that we are considering:

1. Move the date of the contest to a Saturday in April.
2. Add an Elementary Division (grades 4-6)—probably without international ranking.
3. Give everyone two hours to write the programs and 15 minutes to list the programs and sample runs—with no changes permitted during this time.
4. Prohibit the use of any previously prepared subroutines either in written, electronic, or magnetic form. (This hasn't been a problem yet as far as we know.)
5. Require that all code for the language must be standard machine code inherent to the processor of the computer.
6. Provide samples of the correct output for each problem for the local graders use.
7. Clear up any ambiguities in the grading procedure.
8. Set a two-week deadline for the return of the results sheet after the contest.

If you would like to add your input to these suggestions or make new ones, let's hear from you. Your suggestions are always welcome.

Acknowledgement

I would like to thank the many people who helped make this event possible. Tim Fossum, chairman of the Engineering Science Division at the University of Wisconsin—Parkside, helped create the problems and grade the results. Loren Buchanan, president of the Parkside Computer Club, along with members Patty Craig, Kathy Zieman, Brian Kapitan, MaryJane Tropin, Scott MacDowell, and Don Sorenson, helped administer the contest and grade the results. Patty Fields-Troha typed the problems on the Science Division's word processing system. The time and effort contributed by these people was greatly appreciated.

I would also like to thank the many contest directors who contributed their time in directing the local contests and who, in many cases, sent detailed remarks—sometimes several pages long—about how it went.

Finally, I would like to congratulate each individual who participated in this contest. One contest director wrote, "I was amazed at the tenacity of the students. I'm sure glad I didn't have to solve those problems in two hours." Only one team, of course, can "win" this contest in the sense of being ranked first. But from our vantage point, we can see that there are many winners all over the world. These kids have demonstrated their ability to take on a difficult challenge and give it their best shot. And the phrase that we read over and over again in the remarks sent to us which typifies this spirit was: "Wait till next year!" □

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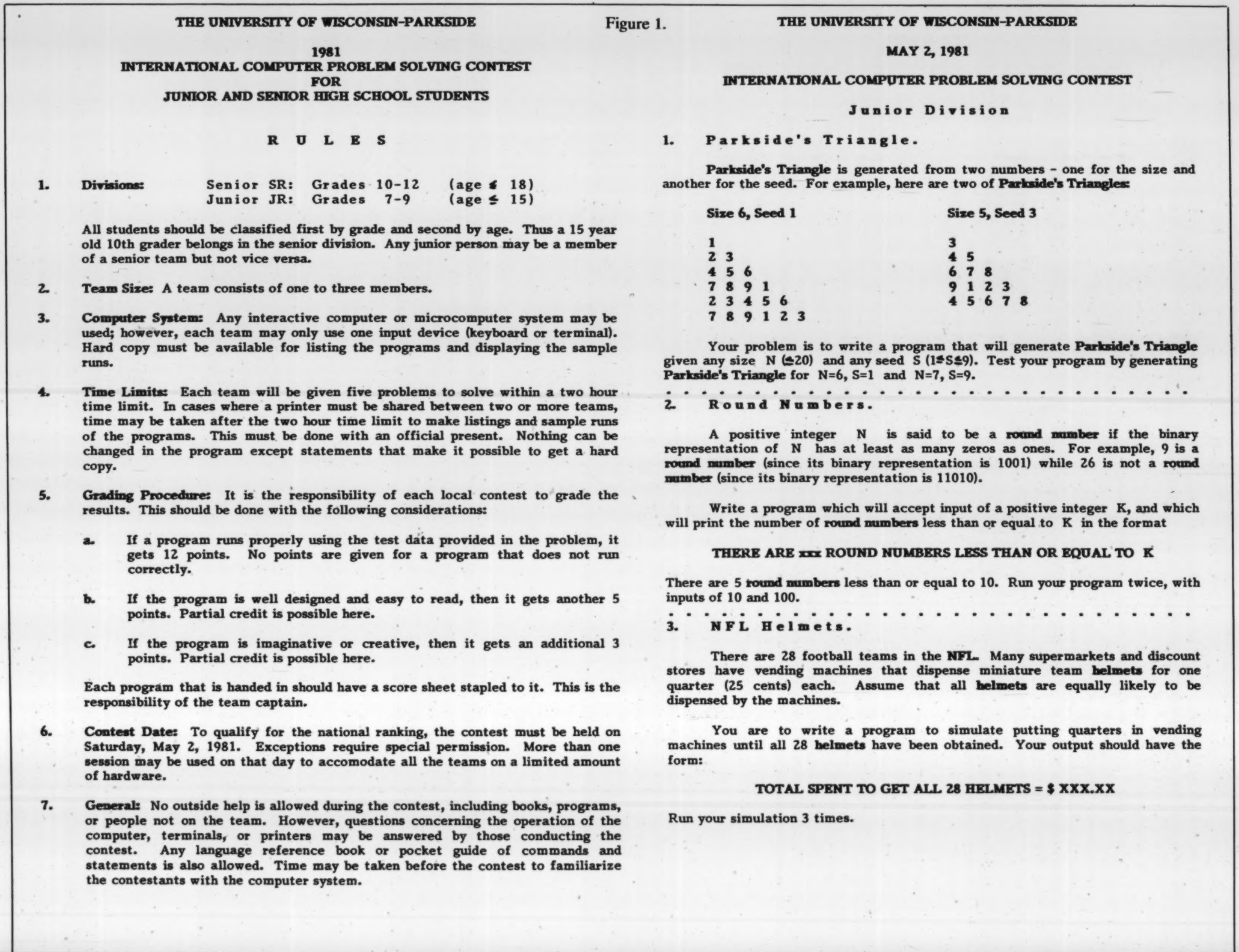


Figure 1.

THE UNIVERSITY OF WISCONSIN-PARKSIDE

1981
INTERNATIONAL COMPUTER PROBLEM SOLVING CONTEST
FOR
JUNIOR AND SENIOR HIGH SCHOOL STUDENTS

RULES

1. **Divisions:** Senior SR: Grades 10-12 (age ≤ 18)
   Junior JR: Grades 7-9 (age ≤ 15)

   All students should be classified first by grade and second by age. Thus a 15 year old 10th grader belongs in the senior division. Any junior person may be a member of a senior team but not vice versa.

2. **Team Size:** A team consists of one to three members.

3. **Computer System:** Any interactive computer or microcomputer system may be used; however, each team may only use one input device (keyboard or terminal). Hard copy must be available for listing the programs and displaying the sample runs.

4. **Time Limits:** Each team will be given five problems to solve within a two hour time limit. In cases where a printer must be shared between two or more teams, time may be taken after the two hour time limit to make listings and sample runs of the programs. This must be done with an official present. Nothing can be changed in the program except statements that make it possible to get a hard copy.

5. **Grading Procedure:** It is the responsibility of each local contest to grade the results. This should be done with the following considerations:

   a. If a program runs properly using the test data provided in the problem, it gets 12 points. No points are given for a program that does not run correctly.

   b. If the program is well designed and easy to read, then it gets another 5 points. Partial credit is possible here.

   c. If the program is imaginative or creative, then it gets an additional 3 points. Partial credit is possible here.

   Each program that is handed in should have a score sheet stapled to it. This is the responsibility of the team captain.

6. **Contest Date:** To qualify for the national ranking, the contest must be held on Saturday, May 2, 1981. Exceptions require special permission. More than one session may be used on that day to accomodate all the teams on a limited amount of hardware.

7. **General:** No outside help is allowed during the contest, including books, programs, or people not on the team. However, questions concerning the operation of the computer, terminals, or printers may be answered by those conducting the contest. Any language reference book or pocket guide of commands and statements is also allowed. Time may be taken before the contest to familiarize the contestants with the computer system.

THE UNIVERSITY OF WISCONSIN-PARKSIDE

MAY 2, 1981

INTERNATIONAL COMPUTER PROBLEM SOLVING CONTEST

Junior Division

1. Parkside's Triangle.

Parkside's Triangle is generated from two numbers - one for the size and another for the seed. For example, here are two of **Parkside's Triangles:**

```
Size 6, Seed 1              Size 5, Seed 3

1                           3
2 3                         4 5
4 5 6                       6 7 8
7 8 9 1                     9 1 2 3
2 3 4 5 6                   4 5 6 7 8
7 8 9 1 2 3
```

Your problem is to write a program that will generate **Parkside's Triangle** given any size N (≤20) and any seed S (1≤S≤9). Test your program by generating **Parkside's Triangle** for N=6, S=1 and N=7, S=9.

. . . .

2. Round Numbers.

A positive integer N is said to be a **round number** if the binary representation of N has at least as many zeros as ones. For example, 9 is a **round number** (since its binary representation is 1001) while 26 is not a **round number** (since its binary representation is 11010).

Write a program which will accept input of a positive integer K, and which will print the number of **round numbers** less than or equal to K in the format

```
THERE ARE xxx ROUND NUMBERS LESS THAN OR EQUAL TO  K
```

There are 5 **round numbers** less than or equal to 10. Run your program twice, with inputs of 10 and 100.

. . . .

3. NFL Helmets.

There are 28 football teams in the **NFL**. Many supermarkets and discount stores have vending machines that dispense miniature team **helmets** for one quarter (25 cents) each. Assume that all **helmets** are equally likely to be dispensed by the machines.

You are to write a program to simulate putting quarters in vending machines until all 28 **helmets** have been obtained. Your output should have the form:

```
TOTAL SPENT TO GET ALL 28 HELMETS = $ XXX.XX
```

Run your simulation 3 times.

THE UNIVERSITY OF WISCONSIN-PARKSIDE

MAY 2, 1981

INTERNATIONAL COMPUTER PROBLEM SOLVING CONTEST

Senior Division

1. Parkside's Other Triangle.

Parkside's Other Triangle is generated from two numbers - one for the size and one for the seed. For example, here are two of **Parkside's Other Triangles:**

```
Size 6, Seed 1              Size 5, Seed 3

1 2 4 7 2 7                 3 4 6 9 4
  3 5 8 3 8                   5 7 1 5
    6 9 4 9                     8 2 6
      1 5 1                       3 7
        6 2                         8
          3
```

Your problem is to write a program that will generate **Parkside's Other Triangle** given any size N (≤ 20) and any seed S ($1 \leq S \leq 9$). This must be done without the use of arrays - which would make the task easy. Test your program by generating **Parkside's Other Triangle** for N=6, S=1 and N=7, S=9.

. . . .

2. The Digital Product

The digital product of a positive integer N is defined to be the product of its nonzero decimal digits. For example, the digital product of 99 is 81. **The digital product root** of a positive integer N is obtained by repeatedly taking **digital products** until a single digit is obtained. Write a program which will accept input of a positive integer up to 70 decimal digits in length, and which will print the intermediate steps in computing its **digital product root.**

For example, for an input of 9999999999, the output should look like

```
9999999999
3486784401
516096
1620
12
2

The digital product root is 2.
```

Run your program with inputs of 7, 100, 123456789, and 9999999999.

4. Letter Count.

Consider a paragraph containing several lines of text information. You are to write a program to print a **letter** frequency table which will list the frequency and percentage of occurences of each **letter** (A through Z) of the text in order of highest frequency first.

Your list should be headed with the line

LETTER FREQUENCY PERCENT

and should have a final line

TOTAL xxx

where xxx is the total number of **letters** in the paragraph. Do not list **letters** which do not occur in the paragraph. In BASIC, you can use DATA statements to enter your text such as,

```
1000 DATA "CONSIDER A PARAGRAPH ..."
```

Be sure to convert all lower-case **letters** to capitals. Test your program with the first paragraph of this problem.

. . . .

5. Missionaries and Cannibals.

On a small island in the South Pacific, three **missionaries** and three **cannibals** are stranded with only a small boat with which to cross over to the mainland. In planning for the transfer of everyone to the mainland the **missionaries** know that they cannot trust the **cannibals.** Thus to be safe they establish the rule that **missionaries** must never be outnumbered by **cannibals** on either the island or the mainland during the transfer process.

If we use an M to represent a **missionary** and a C to represent a **cannibal** then MMMCCC represents three **missionaries** and three **cannibals** together. With this representation, it is possible to list all possible arrangements of **missionaries** and **cannibals** on the island and the mainland in a list:

	ISLAND	MAINLAND	STATUS
1.	MMMCCC		SAFE
2.	MMMCC	C	SAFE
3.	MMMC	CC	SAFE
4.	MMM	CCC	SAFE
5.	MMCCC	M	
6.	etc.	etc.	etc.

The safe positions are those which obey the rule set up by the **missionaries.** Your problem is to write a program which will fill out the entire list of possible arrangements of **missionaries** and **cannibals** on the island and the mainland and to print 'SAFE' after every arrangement that is safe. The program must do all the work. It is not acceptable to solve it by hand and simply print out the results.

3. Bug Walk.

A **bug** begins at home and goes for a random walk on a strip of 2N+1 squares:

-N	...	-3	-2	-1	X	1	2	3	...	N

HOME

It moves to the right or left one square at a time but in a random fashion. It moves to the right with probability P (0<P<1) and it moves to the left with probability 1-P. When the **bug** reaches either end of the strip, its next move is always towards home and then it continues the random walk.

After the **bug** has returned home for the 10th time it stops.

Write a program that simulates the **bug's** random walk for any input of N and P and prints out a list of all the squares the **bug** has visited, and the number of times he has been there. Print out the list in order of frequency, giving the most frequently visited squares first. Run the program for N=5, P=1/2 and N=6, P=2/3.

. . . .

4. Word Count.

Consider a paragraph containing several lines of text information. You are to write a program to print a **word length** frequency table. This table should list the **word length,** frequency of occurences, and percentage, in three columns, in order of highest frequency first.

Your list should be headed with the line

LENGTH FREQUENCY PERCENTAGE

and should have a final line

TOTAL xxx

where xxx is the total number of **words** in the paragraph. For purposes of definition, a **word** consists only of alphabetic characters (A through Z). Notice also that different **words** (such as "FOR" and "THE") having the same length are to be **counted** together in determining the **word length** frequency. Do not list **word** lengths that do not occur in the paragraph.

In BASIC, you can use DATA statements to enter your text such as,

```
1000 DATA "CONSIDER A PARAGRAPH CONTAINING SEVERAL ..."
```

Test your program with the first paragraph of this problem.

5. Shuttle Puzzle.

The **Shuttle Puzzle** of size 3 consists of three white marbles, three black marbles, and a strip of wood with 7 holes. The marbles of the same color are placed in the holes at the opposite ends of the strip leaving the center hole empty (X is empty space).

O O O X ● ● ●

Initial State

The object of the **puzzle** is to completely reverse the marbles on the strip and end up with the goal state:

● ● ● X O O O

Goal State

There are only two types of moves you can use. You may move 1 marble 1 space (into an empty hole) or jump 1 marble over 1 marble of the opposite color (into an empty hole). You may **not** back up and you may **not** jump over 2 marbles.

A **Shuttle Puzzle** of size N consists of N white marbles and N black marbles and 2N + 1 holes.

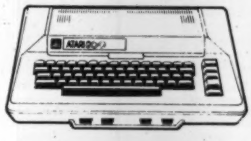
Write a program that will solve the **Shuttle Puzzle** for any size N(≤10) and display the board after each move. Use 0's to represent white marbles and 1's to represent black marbles and X to represent the empty hole. Thus 000X111 is the initial state and 111X000 is the goal state in a **Shuttle Puzzle** of size 3.

Test your program for N=3 and N=4.

HINT: First figure out how to solve the puzzle. Next, observe the movement of the empty space. Finally find the rules that govern the movement of the hole to the left and right and program the computer to carry them out.

Figure 1.

we beat the price...



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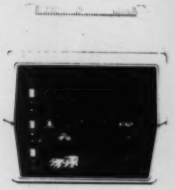

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The Computer Tutor

Harley M. Templeton

"The Computer Tutor" is written for the Texas Instruments 99/4, but don't despair if you use a different machine. The "Using Another Computer" section at the end of the text provides suggestions for conversion to other Basics.

"Child, that's an awful report card! You need a tutor!"

"Aw, gee! Do I have to?"

Sound familiar? How about a computer tutor? Many teaching programs are available for computers. Typically, they teach a particular subject at a general level. They are great—if you need to learn what they teach. But to help your child with current assignments you need something customized for the areas with which he is having difficulty. Or maybe you are a teacher who would like to write lessons, drills, and quizzes that your students can do on an available computer. This article describes two programs for the TI 99/4 which can be used for computer aided instruction. One writes a set of frames (or screens) and the other displays the frames. The result is a teaching tool custom designed for a special purpose.

Lessons, Drills, and Quizzes

The frame builder program writes a set of frames to be displayed by the display driver program. Each frame may contain either a question or information. When the question is a multiple-choice question, the answer can select the frame to be displayed next. True-false questions and questions that have exact, brief answers can also be used. Questions of this type cannot readily select the next frame for display so the next question in the set in displayed. The question can, however, be repeated, giving the student a second chance to get the correct answer.

By a lesson, I mean a series of frames designed primarily for teaching. Each answer selects a frame to be displayed next. The frame following a correct answer should say that the answer is correct, and may include additional information. After each incorrect answer the next frame should tell why the answer is incorrect, and give the correct answer. The display driver can keep score, if you tell it to. The score helps the student to see how he is doing.

In a drill, the questions are displayed in sequence, regardless of the answer. You can specify a repeat to give the student another chance to answer the question. If the second answer is wrong, the display driver displays the correct answer before displaying the next frame. A drill can be scored, too. If both scoring and repeating are requested, the student only scores when the first answer is correct.

A quiz is similar to a drill, except that the student has only one chance to answer. A quiz is usually scored.

The computer tutor gives you a great deal of flexibility. The sequence of display and the options are coded for each frame; types of frames can be combined as appropriate. You can include information frames following question frames. You can mix questions that follow in sequence with those that are displayed in answer-selected sequence. And you can include unscored questions with scored questions. Similarly, you can repeat some questions but not others. You can use questions with a word or phrase as the answer. However, you should use these questions with care; there must be only one correct answer. Otherwise, the student may be told that a correct answer is incorrect. Unless you are teaching spelling, this type of question should probably not be used with a student who has spelling problems.

Preparing the Frames

You should carefully plan the frames before you run the frame builder. Remember that the advantages of this type of instruction are immediate reinforcement of correct answers and correction of wrong answers before they are learned. There is immediate reward for correct answers. An incorrect answer is immediately replaced by the correct answer. The student does not have to wait to get the paper back to learn the correct answer.

You may want to use exercises or tests from a workbook, textbook, or work sheets. Use your imagination to adapt the material to the medium of a computer screen. Exploit the things the computer does: it varies the sequence depending on the student's answer; it recognizes correct answers immediately; and it gives the student the correct answer when his answer is wrong.

The simplest set of frames to write is a drill: state capital, for example. Write each frame as follows:

THE CAPITAL OF TEXAS IS:

The code that follows the frame specifies fixed sequence, score, and repeat. It also includes the correct answer (Austin, for you Yankees!).

Write a number of similar frames. For variety, turn the question around:

TALLAHASSEE IS THE CAPITAL OF:

The coding for the frame is the same as in the previous example; the correct answer is, of course, Florida.

When the frames are displayed, if the

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CIRCLE 226 ON READER SERVICE CARD

student answers correctly, the next question is displayed. When the answer is incorrect, the computer displays:

TRY AGAIN:

If the second answer is incorrect, the computer displays:

THE CORRECT ANSWER IS AUSTIN

In each case, the computer then displays the next question.

Every set of frames must end with a special frame, coded as the last frame. When the display driver displays this frame (a special type of information frame), it requests the student to press ENTER. Then the computer displays the score:

YOU ANSWERED 7 QUESTIONS CORRECTLY.
YOUR SCORE IS 70%

This score means that the student's first answers to seven out of ten questions are correct. The count of questions asked includes only questions coded for scoring. Any other questions in the set do not affect the score.

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CIRCLE 143 ON READER SERVICE CARD

Multiple-choice questions may be used in drills. Write a multiple-choice question as follows:

A NOUN IS:
1 THE ACTION WORD OF A SENTENCE
2 A WORD THAT MODIFIES A NAME
3 THE NAME OF A PERSON, PLACE, OR THING
4 A WORD THAT MODIFIES THE ACTION WORD

A multiple-choice question may have as many as ten choices, and the questions in a set may have a different number of choices.

Another type of question you can use in a drill is the true-false question. Here's an example:

THE HYPOTENUSE IS THE SIDE OF A RIGHT TRIANGLE OPPOSITE THE RIGHT ANGLE
T OR F?

Each type of question may be scored or repeated or both. (But do you really want to repeat a true-false question?)

A set of frames displayed in the sequence determined by the student's answers is more difficult to write. The questions must be multiple choice with numbered answers. Questions may be scored, but not repeated. An example is:

THE FIRST PRESIDENT OF THE UNITED STATES WAS:
1 ABRAHAM LINCOLN
2 GEORGE WASHINGTON
3 BENJAMIN FRANKLIN
4 JOHN ADAMS

The code that follows the frame specifies answer sequence. The sequence is 2,3,4,5 which means that frame 2 is displayed when the answer is 1. Frame 2 is:

ABRAHAM LINCOLN WAS THE 16TH PRESIDENT OF THE UNITED STATES. GEORGE WASHINGTON WAS THE FIRST PRESIDENT.

Frame 3 is displayed when the answer is 2. Frame 3 is:

YOU ARE CORRECT. GEORGE WASHINGTON, THE GENERAL WHO LED OUR TROOPS TO VICTORY IN THE REVOLUTIONARY WAR BECAME OUR FIRST PRESIDENT.

Frame 4 is displayed when the answer is 3. Frame 4 is:

BENJAMIN FRANKLIN LIVED AT THE TIME OF OUR FIRST PRESIDENT. HE WAS OUR MINISTER TO FRANCE DURING THE REVOLUTIONARY WAR. GEORGE WASHINGTON WAS OUR FIRST PRESIDENT.

Frame 5 is displayed when the answer is 4. Frame 5 is:

JOHN ADAMS WAS ELECTED AFTER SERVING AS THE FIRST VICE PRESIDENT. GEORGE WASHINGTON WAS THE FIRST PRESIDENT.

These four frames are coded as information frames. The code for an information frame includes the number of the next frame to be displayed. Usually, these frames specify the same number: the number of the frame of the next question. However, you can specify any frame having a number higher than that of the current frame.

In this example, a different frame was displayed following each answer. If you like, you can display the same frame for more than one answer.

Each set of frames ends with a special type of information frame coded the last frame. All paths through the frames should end at this frame. It might say, for example:

THAT'S ALL, FOLKS!

Writing the Frames

To write a set of frames, load and run frame builder. It begins by displaying a screen of instructions. After you have finished reading them, press the ENTER key to continue.

The computer displays the cassette instructions next. After you rewind the cassette and place it in record mode, the computer writes a leader, clears the screen, and positions the cursor in the lower left corner of the screen. There are only two valid entries when the cursor is at this

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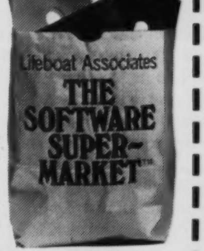

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	1978	1979	1980	Rate	Average	(000's)	1981	1982 *	1985
Item A	**42,323**	**51,891**	**65,123**	24.04	53,112	159.34	80,782	100,206	191,262
Item B	**45,671**	**46,128**	**49,088**	3.67	46,962	140.89	50,891	52,761	58,791
Total	87,994	98,019	114,211	13.93	100,075	300.22	131,673	152,966	250,053
% Item	48.10	52.94	57.02	8.88	52.69	158.1	61.35	65.51	76.49
% Item	51.90	47.06	42.98	-9.00	47.31	141.9	38.65	34.49	23.51
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CIRCLE 216 ON READER SERVICE CARD

Type of frame	Code	Options
Answer sequence	$An_1, n_2,...n_n$ %answer	Scoring option
	$An_1, n_2,...n$	No scoring
Fixed sequence	FR%answer	Repeat and score
	F%answer	Score only
	FRanswer	Repeat only
	F	No scoring, no repeat
Information	In	
Last	L	

n - Number of next frame to be displayed.
n_2 - Number of next frame when answer 1 is entered.
n_n - Number of next frame when answer n is entered
answer - Correct answer to the question.

Table 1. Coding Combinations.

position: a line number, or an exclamation point. Press the ENTER key after the digit of a line number from one to nine. It is not necessary to press the ENTER key after the second digit of a two-digit number. The computer places the cursor on the first character position of the line you requested. Enter any spaces you want at the left of the line. Then type the characters. If you make a mistake, you can use the left arrow key to go back to the incorrect character, and the right arrow key to return to the end of the line. When the line is correct, position the cursor after the last character on the line and press the ENTER key. The cursor returns to the lower left corner of the screen. Then enter another line number and the line of characters in the same way. You can write on any line from 1 to 23 in this way.

The reason frame builder requires you to enter the number of each line is that this technique builds the frame exactly as it will be displayed. If you see that a line contains an error, is too high or too low, enter the line number again. Then correct the error, press the down arrow key to move the line down, or the up arrow key to move the line up. Use the right key to move the cursor to the end of the line and press the ENTER key to store the line.

You may type faster than the computer processes the character you enter. If so, you will lose a character here and there. Try to wait for the cursor before typing a character. The problem is that the required statements and subroutine calls for entering the characters on the upper lines of the screen are slower than the INPUT statement, which enters characters on the bottom line only. The input is programmed this way to build a screen exactly as you want it to be displayed.

When you have the screen just right, and have pressed ENTER to return the cursor to the lower left, enter an exclamation point to start processing of the screen. The computer may not actually write anything on the cassette because it blocks the lines and writes five lines at a time. That is, the computer stores five lines in memory to write with one write operation to the cassette. This speeds up the program significantly because it does not take much longer to write five lines than to write one line.

The computer then displays the following screen to request frame coding information;

FRAME NUMBER 1 ENTER:
A FOR ANSWER SEQUENCE FRAME
F FOR FIXED SEQUENCE FRAME
I FOR INFORMATION FRAME
L FOR LAST FRAME

Entering any of the four letters causes the computer to request the appropriate additional coding. For example, when you enter A, the computer displays:

ENTER A FRAME NUMBER FOR EACH CHOICE. SEPARATE WITH COMMAS. ENCLOSE IN QUOTES.

If you had entered the frame asking who was the first president (previously described), you would now enter:

?"2,3,4,5"

This means to display frame 2 when answer 1 is entered; frame 3 for answer 2; frame 4 for answer 3; and frame 5 for answer 4. The next display is:

ENTER % TO SCORE THE QUESTION, OR PRESS ENTER ONLY.

Press ENTER only, The screen clears, and the computer displays the following:

A2,3,4,5
IF CORRECT, PRESS ! AND ENTER. IF NOT, ENTER CORRECT STRING (ENCLOSED IN QUOTES):

This gives you an opportunity to check and correct the coding line. Had you entered other information, the top line would be different; Table 1 lists the valid combinations. When you enter the exclamation point and press ENTER, the computer writes the code line, clears the screen, and positions the cursor at the lower left, ready for you to write frame 2.

The computer writes the frames in sequence, with a code line after each frame. The only restrictions to the coding are:

- Frame numbers of next frames must be larger than the number of the current frame
- All paths through the set of frames must end at the L frame.

After you have written all the frames, and are ready to respond to the request for the letter that designates the frame type, enter L for the last frame. The computer writes the code line, repeating it, if necessary, to fill the block. The computer then displays the message that tells you to turn off the recorder, and displays the DONE message.

Displaying the Frames

The load and run display driver to display the frames reads the cassette and displays the frames. It interprets the code line that follows each frame, repeating displays and scoring the answers as specified.

The program first displays the cassette instructions. Insert the cassette on which frame builder has written a set of frames, and follow the instructions. Display driver reads a block of five lines, checks for a code line, and stores each line until all five lines have been stored or a code line has been identified. When the computer gets to the code line, it displays the stored lines on the screen and interprets the code.

The I/O firmware in the computer displays a message telling you to turn off the recorder when there is a read error. This is followed by an error message. However, the program expects the frames in sequence, with a code line following each frame. When the computer reads a frame out of sequence, or display line where there should be a code line, it displays the following message:

FRAME SEQUENCE ERROR

Should this message be displayed, rerun the program to make another attempt to read the tape correctly. If the program fails again, run frame builder to write the tape again, carefully checking the contents of the code lines.

When the program displays a frame followed by a code line that starts with the letter A, the frame is an answer sequence frame. The computer displays the following request for an answer:

ENTER NUMBER OF ANSWER:

The computer resumes reading the tape, continuing until it finds the frame that corresponds to the answer. If you have entered zero or a negative number, the

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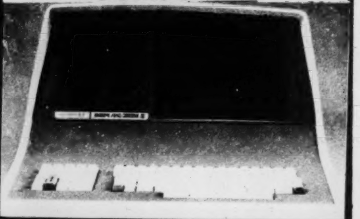

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CIRCLE 130 ON READER SERVICE CARD

computer considers the answer to be 1. If you have entered a number greater than the number of frames specified in the code line, the computer considers the answer to be the largest number for which there is a corresponding frame number. If you enter a letter, the computer displays an error message and gives you another chance. In any case, when the computer reads the requested frame, it processes and displays the lines as it displayed the first frame.

When the code for a line specifies scoring, the computer compares the answer to the correct answer in the code line, and adds one to the score if the answer matches. When an F frame specifies repeat, the computer compares the answer and prints the following message when the answer is not correct:

TRY AGAIN:

When the second answer is also wrong, the computer displays the following message:

THE CORRECT ANSWER IS

and prints the correct answer on the next line.

When the computer reads the code line that consists of the letter L, it checks the count of scored answers. When the count is greater than zero, the computer displays the count, computes the score, and displays the score. Then the computer displays the cassette stop message and the DONE message.

Changing the Programs

The frame builder, Listing 1, and the display driver, Listing 2, are written in Basic for the TI 99/4 Computer. One change you will make if you have a disk drive is to convert to a disk file. Change the OPEN statements, line 160 of Listing 1, and line 105 of Listing 2. Consult your disk manual for the correct format of the OPEN statements.

Another change you might consider will speed up the display of your frames, but limits the number of frames to the number that will fit in memory along with the modified version of display driver. Only display driver is required; you write DATA statements to define the frames.

First, delete the OPEN statement, line 105, the read routine in lines 3000 through 3080, and the CLOSE statement, line 950, of Listing 2. Then replace the GOSUB 3000 statements, lines 140 and 350, as follows:

```
140 READ M,A$
```

Since the READ statements read a numeric variable and a string variable, the DATA statements must supply numeric variables followed by string variables. The numeric variables contain the sum of the number of the line plus the product of the frame number times 100. That is, the

Listing 1.

```
10  REM  COMPUTER TUTOR
20  REM  FRAME BUILDER
30  REM  HARLEY M. TEMPLETON
40  REM  7807 LAZY LANE
50  REM  AUSTIN, TEXAS  78757
60 OPTI ON BASE1
70  DIM L$(24),NR(5),P$(5),LN(24)

80 N = 1
90 NL = 100
100  CALL  CLEAR
110  PRINT "         FRAME BUILDER
     ":::"ENTER A LINE NUMBER OR
     !"::"ENTER THE CHARACTERS FO
     R THE"
120  PRINT "LINE AFTER THE LINE N
     UMBER.":"WHEN YOU ENTER   !
     , THE":"COMPUTER WRITES THE
     FRAME."::
130  PRINT "USE THE LEFT AND RIGH
     T":"ARROWS AS IN THE EDIT MO
     DE.":"THE UP ARROW MOVES TH
     E LINE"
140  PRINT "UP, AND THE DOWN ARRO
     W":"MOVES THE LINE DOWN.":"
     PRESS ENTER TO BEGIN.":::
150  INPUT E$
160 OPEN#7:"CSI", INT ERNAL,OUTPU
     T,FIXED192
170  CALL  CLEAR
180 L2 = 24
190 I = 1
200  GOSUB 3000
210  IF K = 33 THEN 610
220  CALL HCHAR(L2,2 + I,K)
230  IF (K < 49) + (K > 57) < 0 THEN
     200
240 I = I + 1
250 K1 = K - 48
260  GOSUB 3000
270  IF (K > 47) + (K < 58) =  -
     2 THEN 310
280  CALL HCHAR(L2,1,32,32)
290 L2 = K1
300  GOTO 370
310  CALL HCHAR(L2,1,32,32)
320 L2 = K1 * 10 + K - 48
330  IF L2 > 23 THEN 350
340  GOTO 370
350  PRINT L2;"TOO HIGH"
360  GOTO 180
365  REM  ENTER LINE
370  FOR I = 1 TO 28
380  GOSUB 3000
390  IF K = 8 THEN 490
400  IF K = 9 THEN 460
410  IF K = 13 THEN 530
420  IF K = 11 THEN 800
430  IF K = 10 THEN 940
440  CALL HCHAR(L2,2 + I,K)
450  GOTO 520
455  REM  RIGHT ARROW
460  CALL HCHAR(L2,2 + I,T)
465  IF I = 28 THEN 380
470 I = I + 1
480  GOTO 380
485  REM  LEFT ARROW
490  CALL HCHAR(L2,2 + 1,T)
495  IF I = 1 THEN 380
500 I = T - 1
510  GOTO 380
520  NEXT I
525  REM  STORE A LINE
530  CALL HCHAR(L2,2 + I,32)
540 A$ = ""
550  FOR J = 1 TO I
560  CALL GCHAR(L2,2 + J,X)
570 A$ = A$ &  CHR$ (X)
```

```
580  NEXT J
590 L$(L2) = A$
600 LN(L2) = NL + L2
605  GOTO 180
610  FOR I = 1 TO 23
620  IF LN(I) = 0 THEN 670
630 NU = LN(I)
640 R$ = L$(I)
645  GOSUB 4000
650 LN(I) = 0
660 L$(I) = ""
670  NEXT I
680  CALL  CLEAR
690  PRINT "FRAME NUMBER";N;"ENTE
     R:":"A FOR ANSWER SEQUENCE F
     RAME":"F FOR FIXED SEQUENCE
     FRAME"
700  PRINT "I FOR INFORMATION FRA
     ME":"L FOR LAST FRAME"::::::
     :::
710  INPUT E$
720 N = N + 1
730 NL = NL + 100
740  IF E$ = "I" THEN 970
750  IF E$ = "A" THEN 1040
760  IF E$ = "F" THEN 1160
770  IF E$ = "L" THEN 1230
780  INPUT "ENTER A, F, I, OR L,
     PLEASE:":E$
790  GOTO 740
795  REM  UP ARROW
800  IF L2 = 1 THEN 380
805 L = L2
810 L2 = L2 - 1
820 L$(L2) = L$(L)
830 L$(L) = ""
840  CALL HCHAR(L,1,32,32)
850  FOR J = 1 TO  LEN (L$(L2))
860 L1$SEG$(L$(L2),J,1)
870 CH =  ASC (L1$)
880  CALL HCHAR(L2,J + 2,CH)
890  NEXT J
900 LN(L) = 0
910 LN(L2) = NL + L2
930  GOTO 380
935  REM  DOWN ARROW
940  IF L2 = 23 THEN 380
945 L = L2
950 L2 = L2 + 1
960  GOTO 820
965  REM  INFORMATION FRAME
970  PRINT "ENTER NUMBER OF NEXT
     FRAME"
980  INPUT "TO BE DISPLAYED:":E$
990 A$ = "I" & E$
1000  GOSUB 2000
1010 R$ = A$
1015 NU = NL
1020  GOSUB 4000
1030  GOTO 170
1035  REM  ANSWER FRAME
1040  PRINT "ENTER A FRAME NUMBER
      FOR":"EACH CHOICE, SEPARATE
      WITH":"COMMAS, ENCLOSE IN Q
     UOTES."
1050  INPUT E$
1060 A$ = "A" & E$
1070  PRINT "ENTER % TO SCORE THE
      ":"QUESTION, OR PRESS ENTER
     "
1080  INPUT "ONLY.":E$
1090  IF ( LEN (E$) = 0) - ( LEN
     (A$) = 2) =  - 2 THEN 1130
1100  IF ( LEN (E$) = 0) THEN 100
     0
1110  IF E$ <  > "%" THEN 1070
1120 A$ = A$ & E$
1130  INPUT "ENTER CORRECT ANSWER
     :":E$
1140 A$ = A$ & E$
1150  GOTO 1000
1155  REM  FIXED FRAME
1160 A$ = "F"
1170  PRINT "ENTER R TO REPEAT TH
     E":"QUESTION, OR PRESS ENTER
     "
1180  INPUT "ONLY.":E$
1190  IF  LEN (E$) = 0 THEN 1070
1200  IF E$ <  > "R" THEN 1170
1210 A$ = A$ & E$
1220  GOTO 1070
1225  REM  LAST FRAME
1230 A$ = "L"
1240  GOSUB 2000
1250 R$ = A$
1255 NU = NL
1260  GOSUB 4000
1270  CALL  CLEAR
1280  IF X1 = 0 THEN 1310
1290  GOSUB 4000
1300  IF X1 < 5 THEN 1280
1310 CLOSE#7
1320  END
1990  REM  VERIFY CODE
2000  CALL  CLEAR
2010  PRINT A$
2020  PRINT "IF CORRECT, PRESS !"
     :"AND ENTER. IF NOT, ENTER":
     "CORRECT STRING (ENCLOSED IN
     ":"QUOTES):"
2030  INPUT E$
2040  IF E$ = "!" THEN 2070
2050 A$ = E$
2060  GOTO 2010
2070  RETURN
2990  REM  CHARACTER INPUT
3000  CALL GCHAR(L2,2 + I,T)
3010  CALL HCHAR(L2,2 + I,30)
3020  CALL KEY(O,K,S)
3030  IF S = 0 THEN 3020
3040  RETURN
3990  REM  WRITE BLOCK
4000 X1 = X1 + 1
4010 NR(X1) = NU
4020 P$(X1) = R$
4030  IF X1 = 5 THEN 4050
4040  RETURN
4050  PRINT #7:NR(1),P$(1),NR(2),
     P$(2),NR(3),P$(3),NR(4),P$(4
     ),NR(5),P$(5)
4060 X1 = 0
4070  RETURN
```

first numeric variable is a number in the range of 101 through 123; 101 for line 1. The string variable contains the characters for the line. Enclose these characters in quotes. Following the last line for frame 1, the numeric variable must be 200. This is the code line for frame 1. The string variable, enclosed in quotes, must be one of the coding combinations in Table 1.

Place the DATA statements after line 2040. Include as many variables in each DATA statement as possible; you can have as many as 112 characters in a statement. Write the DATA statements for the frames in sequence; end with a code line for the last frame:

N,"L"

Variable N is a multiple of 100, the next greater multiple following the variable for the last line. That is, if you have 11 frames and the last line is line 15, the numeric variable for that line woulld be 1115, and N would be 1200.

If you have a large number of lines to display, you will want to keep display driver as small as possible in order to have the maximum area of memory for DATA statements. Change the DIM state-

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Tutor, continued...

ment, line 70, as follows:

70 DIM L$(23),ANS(10)

You can also leave out statements that are not required for a particular set of frames. For example, if none of the frames in the set is repeated or scored, the statements that compare answers may be omitted (lines 610-650, 810-880, 970-980).

Using Another Computer

Converting frame builder and display driver to run on another computer is not difficult; many of the statements will work as they are shown in the listings. The most important changes are the subroutine calls.

Lines 100, 170, 680, and 2000 of Listing 1, and lines 110 and 1100 of Listing 2 are CALL CLEAR statements. They call a subroutine that clears the screen by displaying spaces in all character positions. Substitute the corresponding statement for your computer.

The CALL HCHAR statements display a character at a specified position on the screen, or specified number of identical characters beginning at a specified position. CALL HCHAR statements appear on lines 220, 280, 310, 440, 460, 490, 530, 840, 880, and 3010 of Listing 1. The first parameter is the line number; the second is the character number; and the third is a numeric variable or number that corresponds to the character code. When a fourth parameter is supplied, as on line 310 of Listing 1, it specifies the number of identical characters to display. Substitute a similar statement for your computer.

If your computer has a PRINT @ statement, you can use it to replace one or more CALL HCHAR statements.

Subroutine GCHAR reads a character from a designated position on the screen. Listing 1 has CALL GCHAR statements on lines 560 and 3000. The first parameter is the line number; the second is the character number; and the third is a numeric variable into which the computer places the code of the character. Replace these statements with similar statements for your computer.

The CALL KEY statement on line 3020 of Listing 1 reads a character from the keyboard. The first parameter is 0, which selects the keyboard. The second parameter is a numeric variable into which the computer places the code of the key you press. The third parameter is the numeric variable for the status code. The status code is zero when no key has been pressed, or ±1 when a key has been pressed. Use the corresponding subroutine of your computer.

The CALL SCREEN statement, line 2030 of Listing 2, produces the colored backgrounds for the display. The value of the parameter selects the color of the screen. If your computer has color, substitute a corresponding statement for your computer. If not, omit lines 2000 through 2040, and the GOSUB 2000 statement on line 193.

The CALL SCREEN statement, line 2030 of Listing 2, produces the colored backgrounds for the display. The value of the parameter selects the color of the screen. If your computer has color, substitute a corresponding statement for your

Listing 2.

```
10  REM  COMPUTER TUTOR
20  REM  DISPLAY DRIVER
30  REM  HARLEY M. TEMPLETON
40  REM  7907 LAZY LANE
50  REM  AUSTIN, TEXAS  78757
60 OPTI ON BASE1
70  DIM L$(23),ANS(10),NL(5),LL$(
     5)
80 N = 100
90 C = 2
100 R AND OMIZE
105 OPEN#7:"CSI", INT ERNAL, INPUT
     ,FIXED192
110  CALL  CLEAR
120 P = N + 100
140  GOSUB 3000
150  IF M = P THEN 190
160  IF (M < N) + (M > P) < 0 THEN
     290
165 I = M - N
170 L$(I) = A$
180  GOTO 140
190 T$ = A$
193  GOSUB 2000
195  FOR J = 1 TO 23
197  PRINT L$(J)
235 L$(J) = ""
240  NEXT J
245 E$ = SEG$(T$,1,1)
250  IF E$ = "A" THEN 370
260  IF E$ = "F" THEN 720
270  IF E$ = "I" THEN 310
280  IF E$ = "L" THEN 930
290  PRINT "FRAME SEQUENCE ERROR"

300  STOP
305  REM  PROCESS I FRAME
310 F$ = SEG$(T$,2,3)
320 N =  VAL (F$)
330  INPUT "PRESS ENTER":E$
335 N = N * 100
340  IF N = P THEN 110
350  GOSUB 3000
360  IF M = N THEN 110ELSE350
365  REM  PROCESS A FRAME
370 S$ = ""
380 X =  POS (T$,"%",2)
390  IF X = 0 THEN 510
400 S$ = S$ & SEG$(T$,X + 1,2)
410 J = 1
420 W = 2
430 Y =  POS (T$,X + 1,W)
440  IF Y = 0 THEN 530
450 Z = Y - W
460 F$ = SEG$(T$,W,Z)
470 ANS(J) =  VAL (F$)
480 W = Y + 1
490 J = J + 1
500  GOTO 430
510 X =  LEN (T$) + 1
520  GOTO 410
530 Z = X - W
540 F$ = SEG$(T$,W,Z)
550 ANS(J) =  VAL (F$)
```

computer. If not, omit lines 2000 through 2040, and the GOSUB 2000 statement on line 193.

The OPTION BASE statements on line 60 of each listing set the lower limit of all array subscripts to 1. The statements save a bit of memory, but can be omitted if your computer does not have a similar statement.

Probably many of the functions are the same on your computer. Function CHR$ is a string function that returns the character corresponding to a numeric code. It is used in a statement on line 570 of Listing 1. Function LEN returns the length of a string. It is used in the statements on lines 850, 1090, 1100, and 1190 of Listing 1, and on lines 510 and 750 of Listing 2. Function SEG$ is a string function that returns a designated portion of a string. The first parameter is the string variable name; the second parameter is the position of the first of character the portion; and the third parameter is the length of the portion to be returned. SEG$ is used in statements on line 860 of Listing 1 and lines 245, 310, 400, 460, 540, 740, 770, 800, 900, 970 of Listing 2.

```
 560  INPUT "ENTER NUMBER OF ANSWE
     R:":Q
 570  IF Q > J THEN 680
 580  IF Q < 1 THEN 700
 590 N = ANS(Q)
 600  IF S$ = "" THEN 335
 610 S = S + 1
 620  IF S$ = STR(Q) THEN 640
 630  GOTO 335
 640 A = A + 1
 650  GOTO 335
 680 N = ANS(J)
 690  GOTO 600
 700 N = ANS(1)
 710  GOTO 600
 720 N = N + 100
 730  INPUT "ANSWER:":E$
 740 F$ = SEG$(T$,2,1)
 750  IF  LEN (F$) = 0 THEN 110
 760  IF F$ <  > "R" THEN 900
 770 G$ = SEG$(T$,3.1)
 780  IF G$ <  > "%" THEN 970
 800 S$ = SEG$(T$,4,20)
 810 S = S + 1
 820  IF E$ = S$ THEN 870
 830  INPUT "TRY AGAIN:":E$
 840  IF E$ = S$ THEN 110
 850  PRINT "THE CORRECT ANSWER IS
       ":S$
 855  INPUT "PRESS ENTER":E$
 860  GOTO 110
 870 A = A + 1
 880  GOTO 110
 900 S$ = SEG$(T$,3,20)
 910 S = S + 1
 920  IF E$ = S$ THEN 870ELSE850
 925  REM  PROCESS L FRAME
 930  INPUT "PRESS ENTER":E$
 940  IF S > 0 THEN 1100
 950 CLOSE#7
 960  END
 970 S$ = SEG$(T$,3,20)
 980  IF E$ = S$ THEN 110ELSE830
1090  REM  DISPLAY SCORE
1100  CALL  CLEAR
1110  PRINT "YOU ANSWERED";A;"QUE
     STIONS":"CORRECTLY."
1120 P =  INT (A / S * 100)
1130  PRINT "YOUR SCORE IS";P;"%"

1140  GOTO 950
1990  REM  SCREEN COLOR
2000 COL =  INT (13 *  RND ) + 3
2030  CALL SCREEN(COL)
2040  RETURN
2990  REM  READ BLOCK
3000  IF X1 > 0 THEN 3030
3010  INPUT #7:NL(1),LL$(1),NL(2)
     ,LL$(2),NL(3),LL$(3),NL(4),L
     L$(4),NL(5),LL$(5)
3020 X1 = 1
3030 M = NL(X1)
3040 A$ = LL$(X1)
3050 X1 = X1 + 1
3060  IF X1 < 6 THEN 3080
3070 X1 = 0
3080  RETURN
```

Function ASC, used on line 870 of Listing 1, returns the code of the first character of the string. Function VAL appears on lines 320, 470, and 550 of Listing 2. It returns the numeric value of a string that represents a number. Function POS is not available on some computers, but a subroutine that does the same thing can be used. The function returns the number of the position of the first appearance of a character or string within a string. Specify the larger string as the first parameter, the smaller string as the second parameter, and the position of the character at which to begin as the third parameter. Function POS is used on lines 380 and 430 of Listing 2. Function STR$ is used on line 620 of Listing 2; it returns the string that represents the value of a numeric variable. The familiar integer function, which returns the largest integer that is not greater than the parameter, is used on lines 1120 and 2000 of Listing 2. The RND function is also used on line 2000. It returns a random number between 0 and 1.

The other change you may want to make in the programs adapts to a different screen size. The screen of the TI 99/4 displays 24 lines of 28 characters each. The size of arrays L$ and LN (DIM statement, line 70, Listing 1) is 24, the number of lines on the screen. The statement on line 180 assigns the value of 24 to variable L2. Replace 24 in these statements with the number of lines on the screen of your computer. Several statements use the number 23, the number of lines minus one. These include an IF statement on line 330, a FOR TO statement on line 610, and an IF statement on line 940, all on Listing 1. In Listing 2, the size of array L$ in the DIM statement on line 70 is 23. The value is also used in a FOR TO statement on line 195. Change these statements, replacing 23 with a value that is one less than the number of lines on the screen of your computer. Only one statement uses 28, the number of characters per line. It is a FOR TO statement on line 370 of Listing 1. Replace 28 with the number of characters on each line of your computer screen. ☐

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Slalom

Alfred J. Bruey

Slalom simulates a downhill ski race. It uses the high speed text scrolling capabilities of the Apple II. Slalom has been trimmed down to quicken its execution time. The object of Slalom is to maneuver the skier (represented by the '()') keeping him between the two poles. This is done by using paddle 0.

When you run the program, you will see HEIGHT?SIZE? GATES? appear at the top of the screen. You should then input three numbers: 1) HEIGHT—A number from 1 to 23, which represents the location of the skier and the time delay between gates; 2) SIZE—A number between 1 and 38, which dictates the width of the gates; 3) GATES—A number which tells how many gates are desired.

At the end of the program the computer tells you the number of gates missed or hit and the percentage of gates missed.

```
1   HOME : PRINT "HEIGHT?SIZE?GATES";: INPUT H,G,A:Z = 24:V =2
      : FOR L = 1 TO A:X = INT ( RND (1) * (37 - G)) + V: VTAB 23
      : HTAB X: PRINT "I";: HTAB X + G: PRINT "I"
2   FOR R = 1 TO Z - H:Q = INT ( PDL (0) / 7): VTAB H: HTAB Q:
      PRINT"0":VTAB Z: PRINT : NEXT
3   IF ABS (Q - X -G / V)     = G / V THEN VTAB Z - V: HTAB V +
      Q:F = F + 1: PRINT "BANG"
4    NEXT : PRINT F " / "A, INT (F * 100 / A)"%": END
```

Alfred J. Bruey, 201 S. Grinnell St., Jackson, MI 49203.

Bombproofing the PET INPUT Statement

Teddy Nadeau

Teddy Nadeau, 10 Surf St., Marblehead, MA 01945.

Much has appeared in the PET literature recently concerning the advantages of using the GET command instead of the INPUT command in Basic programs.

The GET instruction is useful if, for some reason, you need to count characters as they are entered. But there is no reason to resort to the lengthy coding of the GET statement simply to keep from breaking out of the program by pressing the RETURN or STOP key. The INPUT statement is capable of handling this situation easily.

As an example, enter the following three Basic instructions

```
10 INPUT "HOW MANY $$ Δ←←←   ;" A$
20 IF A$="Δ" THEN PRINT " ↑↑ ":GOTO 10
30 PRINT A$:STOP
```

$ = space
Δ = shifted space
← = cursor left
↑ = cursor up

Now run the program. Notice that nothing happens if you press the RETURN or STOP key. That's because when the RETURN key is pressed, the IF statement in line 20 sees a shifted space character and returns to line 10 for a different character. Note that this can be extended to characters other than the shifted blank. If, for example, you were asking a user to enter Y or N for a yes or no and you expected him to enter a Y normally, you could enter the line

```
10 INPUT "ANSWER $$ Y ←←← ";A$
```

Then if the user presses the RETURN, the Y will be entered for him as the default value. Otherwise he can press N before he presses the RETURN key and the Y will be overwritten with the N.

I'm sure you'll find this easier to use than the GET statement in places where you want to protect the user from the RETURN key. □

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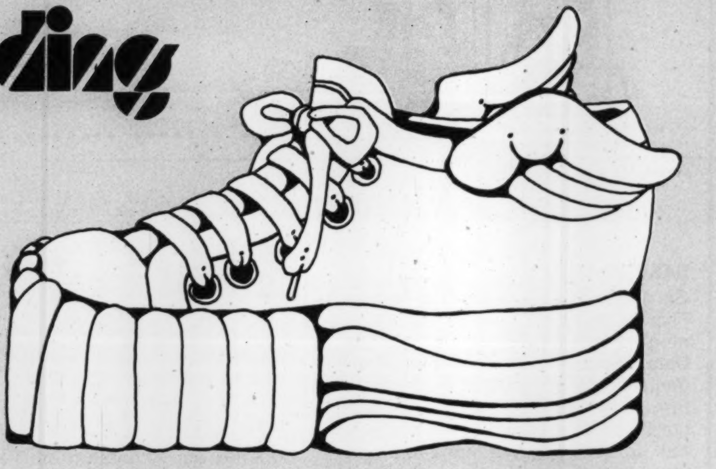
CIRCLE 156 ON READER SERVICE CARD

speed reading with the personal computer



Robert Wayne Smith

One of the first things you learn in any speed reading course is that to become proficient you must practice: practice reading sentences and phrases as units rather than plodding along looking at each word individually. A common suggestion is to practice with a light novel in which actual content is not important. Don't worry about every detail, just try to see whole sentences as you move your hand down the page and never, but never, go back to re-read a sentence that you didn't quite get. At first you may understand little of what you see, but with practice your mind does begin to grasp phrases and sentences without stopping to read or, Heaven forbid, say each word.

The following program, written in Atari Basic, does not constitute a speed reading course. Rather it is a tool which allows you to build up your speed gradually as it helps you begin to comprehend groups of words and entire sentences.

There are four basic options: single words, phrases, short sentences, and longer, complex sentences. With each option you choose the number of words per minute that will appear on the screen. If you are a verbalizer, that is if you say each word to yourself as you read, you will find that as you increase your speed in option 1 to five or six hundred words per minute you will understand single words but have no time to say them. This skill can be transferred to longer units as you progress to options 2, 3 and 4. If you are already a fast reader, you will still find option 4 challenging at 2500 words per minute. The ability to select the speed and the inability to go back and re-read a sentence make the computer an ideal reading tool.

The basic idea behind the program occurred to me after reading the String Array Demonstration in George Blank's "Outpost: Atari" in the October 1980 issue of *Creative Computing*. The program uses a single string array, A$, which contains nine sets of words and phrases chosen in such a way that a random selection from each set produces a sentence. As you might imagine, the sentences are sometimes a little peculiar, for example: "As the bold elephant meditated skeptically on the roof, Albert drank tea." Remember that content is of secondary importance.

The sentences are created via random choices from an address matrix, AL, which contains the location of every word in each set. Each of the nine sets contains 12 words or phrases, with a few repetitions, so that almost two million distinct sentences can be created. It would be very simple to increase the number of words in each set, or just to change them to suit your own preference.

Another simple modification is to vary the setcolor and color commands. I mention this because my black and white TV renders me color blind. You can change the display to dark letters on a light background by changing to "Setcolor 4,8,14." It may occur to experienced programmers that it would be possible to shorten the program by using a subroutine and a few conditional statements. There are several places where I have sacrificed elegance for speed.

The program controls the words per minute by leaving the display on for the time it takes the Atari to finish an empty "for next" loop (line 165 for option 4). A little statistical analysis indicates that there is a very strong relationship between the words per minute and the length of the delay. For the complex sentences, which average 11 words, the relationship is given in line 37. To arrive at this equation, the real time clock described by George Blank in the September 1980 issue of *Creative Computing* was used to calculate the time it took to print 30 sentences using different delays. I have left the time in line 108 and lines 180-185 in case anyone wants to check. The required changes are:

```
110 For N=1 TO 30
170 NEXT N
```

Of course, if you convert the program for another computer, you are on your own, but a stopwatch would probably be adequate to calculate words per minute. □

Robert Wayne Smith, Department of Mathematics, University of Puerto Rico, Mayaguez, Puerto Rico, 00708.

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BY
SCOT KAMINS, Ph.D.

TEACH BY COMPUTER

Now you can teach in two places at the same time! Using an Apple computer and The Learning System, you may give individualized attention to your special students, supplementary work for those who finish assignments early, or add excitement to regular classroom work while teaching in your usual manner. For the Media/Resource Center or the classroom, as a library of classroom courseware or a teaching tool, The Learning System will be indispensible.

ANYONE CAN USE IT

There is no programing skill or special instruction needed to set-up or operate the program. Simply type in the information you wish to teach then make up the test questions (fill-in, multiple choice, or column match) to correspond to specific sections of that information. Hints, encouragement, and help are part of the tutorial mode.

TUTORIAL LEARNING

After reading the information, the learner may not recall the answer to a question. At that point, in the tutorial mode, he may go back to reread all or just the appropriate part of the information that refers to that question. With this positive approach, the student receives the reinforcement needed to learn the material.

TESTING/GRADING

In the exam mode one may not go back to reread the information. Complete recording of scores and an analysis of those results are part of the system. Averages of a students grades, comparisons of grades of all students taking the same exam, and question validity are functions designed to help you with grading and to let you know where there are learning difficulties. Printouts of the information, the exams, and the analysis will also aid you. Since the questions are automatically scrambled with each test given, you can get additional printouts of the same question set to have individualized copies of an exam to discourage "answer comparisons" during an exam.

SCORE ANALYSIS

Test results may be evaluated on many levels: for analysis of the user's strengths or weaknesses; comparison to others who have taken the same exam; as a device for the instructor to see how well he has taught the material; or to evaluate the validity of the questions used. Comparing the results of many exams from an entire class, the instructor can see what must be retaught. He can check the percentage of users that answered each question correctly or incorrectly to establish whether it was a fair one. The class curve can easily be computed. Grades can be given without spending days computing and averaging exam scores.

NEW APPROACH TO LEARNING

There have been other testing programs on the market, but this one is different. It is not just a testing device to see what someone already knows, but a learning system that teaches new information. We had heard the usual comments that programs are rather poor educational tools because they are written by machine people, not educators. Then we found Dr. Scot Kamins. He has the unique background of being both an educator and a programmer and understands the requirements of both disciplines.

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This description of The Learning System is meant to stimulate your thoughts about its applications in your school. The system has so much potential that only a brief summary of its features can be described here.

SPECIAL APPLICATIONS

Extra help is already available for students who need additional practice for special exams in U.S. Constitution and English SAT's. Their grades will be significantly increased with these aids. The key to the success of these programs lies in the fall-through technique. When a question is answered correctly or incorrectly, the learner is told why that answer was right or wrong. This helps the user to understand the basis of the question or why a lucky guess was correct.

The English SAT Tutorial was written by Eileen Shapiro, a specialist in tutorial education. Her work, teaching tutors more effective methods as well as her educational material, has been widely published. Myrna Helfand has been a creative, proficient teacher of U.S. Constitution and was concerned with more effective teaching methods for many years. The efforts of these two exceptional educators have made each program an exciting addition to our commitment to education in the Micro Lab Learning Center.

See a demo at your local Apple Dealer. The Learning System is priced at $150; while The SAT English Tutorial is $25, and the U.S. Constitution is $30.

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CIRCLE 155 ON READER SERVICE CARD

Speed Reading Program

```
1 REM **********************
2 REM BY R.W.SMITH OCT.1980
3 REM **********************
5 DIM A$(660),AL(9,15),Q$(25)
6 A$=" ":Q$=" "
7 GRAPHICS 1:SETCOLOR 1,8,14:COLOR 5
8 ? #6;"-------------------"
9 ? #6;"** SPEED READING **"
10 ? #6;"-------------------"
11 ? #6;"TO PRACTICE WITH "
16 ? #6;"WORDS.......(TYPE 1)"
17 ? #6;"PHRASES.....(TYPE 2)"
18 ? #6;"SHORT SEN...(TYPE 3)"
19 ? #6;"SENTENCES...(TYPE 4)"
21 ? #6;"THEN CHOOSE W.P.M."
22 ? #6
23 ? #6;"WORDS       50..650"
24 ? #6;"PHRASES     50..1200"
25 ? #6;"SHORT SEN. 50..1450"
27 ? #6;"SENTENCES  50..2500"
28 PRINT "WHICH OPTION? "
29 INPUT O
30 PRINT "W.P.M.= ";
32 INPUT W
34 IF O=1 THEN DELAY=5370/W-7.2
35 IF O=2 THEN DELAY=10076.6/W-7
36 IF O=3 THEN DELAY=18903.5/W-11.5
37 IF O=4 THEN DELAY=128008.7/W-50.7
38 DELAY=INT(DELAY)
40 FOR I=1 TO 9
45 FOR N=1 TO 12
50 AL(I,N)=LEN(A$)+1
60 READ Q$
70 A$(AL(I,N))=Q$
80 NEXT N
90 AL(I,13)=AL(I,12)+LEN(Q$)
100 NEXT I
105 R1=1:R2=2:R3=3:R4=4
106 R5=5:R6=6:R7=7:R8=8
107 POKE 20,0:POKE 19,0:POKE 18,0
108 ON O GOTO 300,400,200,110
110 REM PRINT SENTENCES
120 GRAPHICS 2+16:SETCOLOR 1,8,14
121 COLOR 1
122 IF POS<=6 THEN POS=POS+3
123 IF POS>6 THEN POS=0
125 POSITION 0,POS
132 R9=R8:R8=R7:R7=R6:R6=R5
133 R5=R4:R4=R3:R3=R2:R2=R1
134 R1=INT(RND(5)*12+1)
140 RED=R1+R2
145 IF RED<10 THEN 152
150 ? #6;A$(AL(1,R1),AL(1,R1+1)-1);" ";
152 ? #6;A$(AL(2,R2),AL(2,R2+1)-1);" "
153 ? #6;A$(AL(3,R3),AL(3,R3+1)-1);" ";
154 ? #6;A$(AL(4,R4),AL(4,R4+1)-1);" "
155 ? #6;A$(AL(5,R5),AL(5,R5+1)-1);" ";
156 ? #6;A$(AL(6,R6),AL(6,R6+1)-1);" "
157 ? #6;A$(AL(7,R7),AL(7,R7+1)-1);" "
158 IF RED<10 THEN 165
159 ? #6;A$(AL(8,R8),AL(8,R8+1)-1);" ";
160 ? #6;A$(AL(9,R9),AL(9,R9+1)-1);" "
165 FOR T=1 TO DELAY:NEXT T
170 GOTO 110
180 A=PEEK(20):B=PEEK(19):C=PEEK(18)
185 SEC=(A+B*256+C*65536)/60
188 PRINT SEC
190 PRINT "W.P.M.=";(330/SEC)*60
195 STOP
200 REM SHORT SENTENCES
205 GRAPHICS 2+16:SETCOLOR 1,8,14
207 COLOR 8
210 IF POS<=8 THEN POS=POS+2
215 IF POS>8 THEN POS=0
220 POSITION 0,POS
225 FOR T=1 TO DELAY:NEXT T
227 R4=R3:R3=R2:R2=R1
230 R1=INT(RND(4)*12+1)
235 IF RND(9)<0.4 THEN 250
240 ? #6;A$(AL(2,R1),AL(2,R1+1)-1);" ";
242 ? #6;A$(AL(3,R2),AL(3,R2+1)-1);" ";
243 ? #6;A$(AL(4,R3),AL(4,R3+1)-1);" ";
244 ? #6;A$(AL(5,R4),AL(5,R4+1)-1)
245 GOTO 260
250 ? #6;A$(AL(8,R1),AL(8,R1+1)-1);" ";
252 ? #6;A$(AL(9,R2),AL(9,R2+1)-1)
260 FOR T=1 TO DELAY:NEXT T
265 GOTO 200
300 REM PRINT WORDS
305 GRAPHICS 2+16:SETCOLOR 1,8,14
307 COLOR 8
310 IF POS<=10 THEN POS=POS+2
315 IF POS>10 THEN POS=0
320 POSITION 2,POS
325 FOR T=1 TO DELAY:NEXT T
330 R1=INT(RND(4)*12+1)
335 R2=INT(RND(9)*9+1)
337 IF R2=7 THEN R2=5
340 ? #6;A$(AL(R2,R1),AL(R2,R1+1)-1)
360 FOR T=1 TO DELAY:NEXT T
365 GOTO 300
400 REM PRINT PHRASES
405 GRAPHICS 2+16:SETCOLOR 1,8,14
407 COLOR 8
410 IF POS<=8 THEN POS=POS+2
415 IF POS>8 THEN POS=0
420 POSITION 0,POS
425 FOR T=1 TO DELAY:NEXT T
430 R2=R1
433 R=RND(5)
435 R1=INT(RND(5)*12+1)
440 IF R>0.6 THEN 485
441 IF R>0.3 THEN 470
442 ? #6;A$(AL(5,R1),AL(5,R1+1)-1);" ";
445 ? #6;A$(AL(6,R2),AL(6,R2+1)-1)
450 GOTO 495
470 ? #6;A$(AL(2,R1),AL(2,R1+1)-1);" ";
480 ? #6;A$(AL(3,R2),AL(3,R2+1)-1);" ";
482 ? #6;A$(AL(4,R1),AL(4,R1+1)-1)
483 GOTO 495
485 ? #6;A$(AL(7,R1),AL(7,R1+1)-1)
495 FOR T=1 TO DELAY:NEXT T
496 GOTO 400
500 DATA AS,WHEN,WHILE,UNTIL,ALTHOUGH
505 DATA BECAUSE,SINCE,EVEN THOUGH,AS
510 DATA JUST AS,SINCE,WHEN
515 REM
520 DATA THE,A,THIS,THAT,THE,A,THIS
525 DATA THAT,THE,A,THIS,THAT
```

```
530 REM
535 DATA SMART,SKINNY,KIND,GOOD
540 DATA FAT,HUNGRY,BALD,DIRTY,SLOW
545 DATA PICKY,GREASY,SLY
550 REM
555 DATA STUDENT,BOY,DOG,CAT,DANCER
560 DATA BAKER,MONKEY,ELEPHANT,MAN
565 DATA TEACHER,WOMAN,GROUP
570 REM
575 DATA WALKED,LOOKED,WROTE
580 DATA JUMPED,RAN,TALKED
585 DATA SANG,WIGGLED,WORKED
590 DATA SKIPPED,MEDITATED,DRANK
600 REM
605 DATA CALMLY,SKEPTICALLY,SLOWLY
610 DATA SADLY,WARILY,RAPIDLY
615 DATA CAUTIOUSLY,STEADILY,OPENLY
620 DATA QUIETLY,HAPPILY,CAREFULLY
625 REM
630 DATA UNDER THE TREE,WITH A FRIEND
635 DATA IN THE LIBRARY,ON THE BED
640 DATA OVER THE HILL,NEAR THE HOUSE
645 DATA TO AN AUDIENCE,FOR A DOLLAR
650 DATA IN A CORNER,ON THE FLOOR
655 DATA IN THE KITCHEN,ON THE ROOF
660 REM
665 DATA HE,SHE,IT,THEY,WE,YOU,MOTHER
670 DATA HARRY,ALBERT,SUE,NELLY,I
675 REM
680 DATA MEOWED,YELLED,SAT DOWN,CAME
685 DATA RAN AWAY,COMPLAINED,LAUGHED
690 DATA STOPPED,DRANK TEA,CHOKED
695 DATA LEFT,SMILED
```

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CIRCLE 283 ON READER SERVICE CARD

Computer Lawnmower

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Dr. Sylvia Charp and Marion Ball wanted a way to introduce basic computer concepts to children in grades 5 to 9 of the Philadelphia City Schools. So they identified some tasks that kids understood like mowing lawns, issuing paychecks and controlling traffic lights. They showed how computers are used in these tasks.

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They then wrote a light-hearted but informative text to tie it all together. It talked about kinds of computers, what goes on inside the machine, the language of the computer and how computers work for us.

They took the problem of averaging class grades and showed how a simple yrogram could be written to do this job.

Well-qualified authors

Marion Ball has written other books on computer literacy. Sylvia Charp is the director of educational compuuting for Philadelphia City Schools. They pooled their talents to produce this book, Be A Computer Literate.

This easy-to-read book explains how computers are used in medicine, law enforcement, art, business, transportation and education. It's interesting and understandable.

Too much demand

The Bell System distributed 50,000 copies to schools throughout the U.S. but they couldn't meet the continuing demand. So Creative Computing Press now distributes the book. It's just $3.95 plus $1.00 shipping and handling. Send name and address plus payment or credit card number and expiration date to Creative Computing Press, Morris Plains, NJ 07950. Visa, MasterCard and American Express orders may also be called in toll-free to 800-631-8112 (in NJ 201-540-0445).

Order yours today. If, after reading it, you do not feel that you are "computer literate," return it for a full refund plus your postage to send it back.

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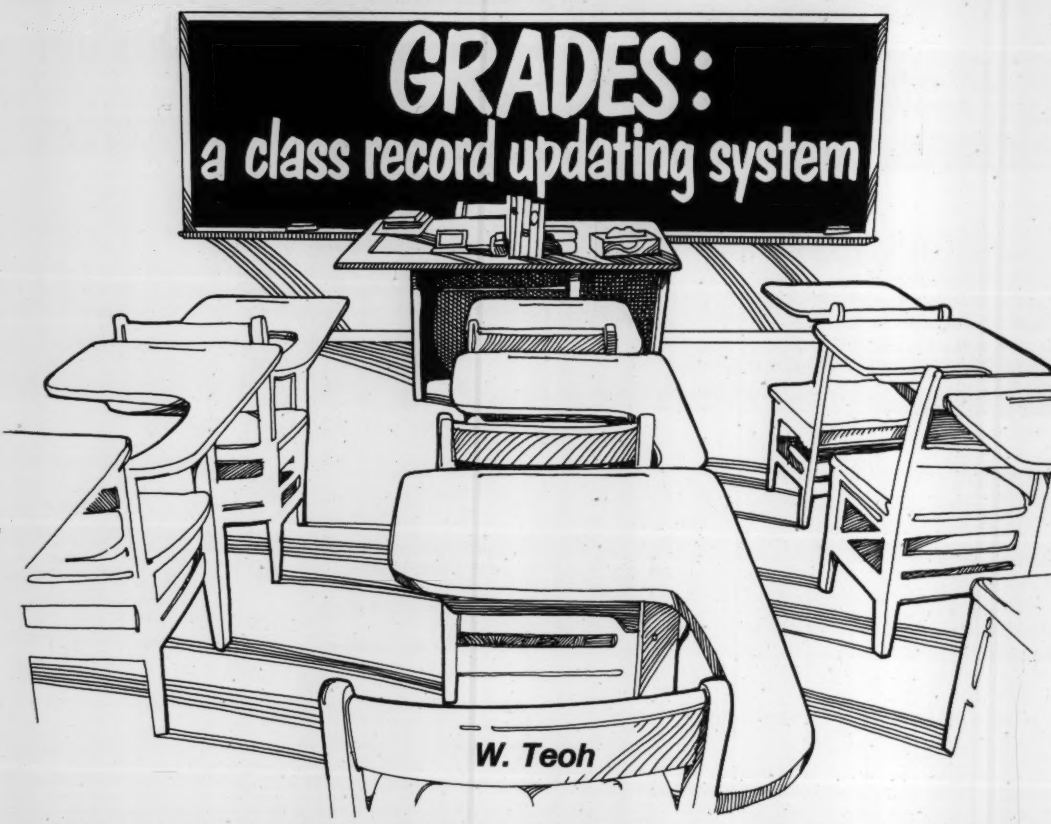
CIRCLE 350 ON READER SERVICE CARD

GRADES:
a class record updating system

W. Teoh



As microcomputers become more affordable, it has become quite common to find them in schools, colleges and homes. It is obvious to a teacher that a computer can take over many routine chores. Maintaining and updating students' grades in a course for example is a task that can be easily handled with the help of a microcomputer.

A program to achieve this task must have the usual capability to enter, update, list, change or delete grades. In addition, it must be able to handle records where the number of students may fluctuate, as in adult education or introductory courses where the drop-out rate may be high.

A flexible program should allow an instructor to enter his subject title (by subject title I mean any homework, quiz, test, project or exam that is an integral part of a course). The program should also be able to produce a final grade for each student based on the weighted mean (as chosen by the user) of all the scores of all subjects. Finally, it should be able to display some of the information (such as the class average of a subject) graphically, and to produce hard copies if a printer is available.

Grades is a class record updating system that performs all these functions. It is written in Basic in conversation mode; whenever input is required from the keyboard, the computer first prints a suitable message, and then waits for the user's response. The minimum system required to run Grades consists of a 48K Apple II Plus (or Apple II with Applesoft in ROM) and a single disk drive. A printer is optional.

Available Functions

When the program is loaded and executed, Grades first requests the course name. One can enter a course designator such as CIS-118, or HISTORY or whatever is suitable. The user is then presented with the main menu as shown in Figure 1, where a code is displayed with the corresponding function.

If this is a new course, one should respond with a 0 (for utilities) at which point one is presented with a utility menu as shown in Figure 2. The Initialize utility (code 1) allows the program to perform the necessary initialization, after which the user is asked to enter the class list (names of the students in this course).

Figure 1. Grades Program.

```
CODE   ULTILITY
0      RETURN
1      INITIALIZE
2      COPY DATA FILES
3      NAME CHANGE
4      SUBJECT CHANGE
5      SUBJECT SORT
6      DELETE SUBJECT
7      DELETE COURSE

ENTER CODE -
```

Figure 2. Utilities.

```
COURSE :

CODE   FUNCTION
0      ULTILITIES
1      ADD STUDENT
2      DELETE STUDENT
3      ENTER GRADE
4      CHANGE GRADE
5      LIST GRADE
6      FINAL GRADE
7      CLASS AVERAGE
8      CLASS LIST
9      EXIT PROGRAM

ENTER CODE -
```

Dr. W. Teoh, Dept. of Computer Technology, Purdue University at Fort Wayne, 2102 Colesium Blvd. E., Fort Wayne, IN 46805.

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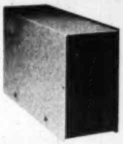

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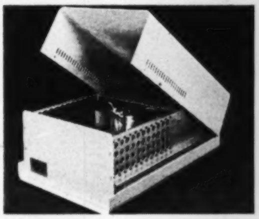

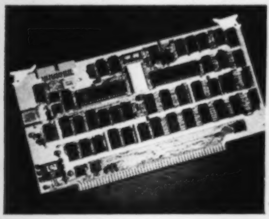

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Grades, continued...

It is not necessary to enter the names in alphabetical order, as a bubble sort is automatically carried out when the list is completed (that is, when the user enters a ZZZ for a student's name).

The program then returns to the main menu to allow the user to choose another function. A short description of each of the available functions is presented below:

1. Utilities (code 0). This function allows one to use any of the available utilities.

2. Add Student (code 1). This allows one to add one or more students to an existing class list. Grades repeatedly asks for the name of a student to be added. Entering ZZZ terminates this mode, at which time, a bubble sort is invoked, so that the class list is always stored in alphabetical order.

3. Delete Student (code 2). This allows the user to delete one or more students from the existing class list. One also enters ZZZ to terminate.

4. Enter Grade (code 3). When this function is invoked, the program will ask the user to enter the subject title, such as HW-1, QZ-2 and so on. One could easily use any other subject designator. Grades then displays each student's name, in alphabetical order, and waits for the user to enter the grades in this subject.

It should be noted that a student may not have a grade for this subject due to illness or be otherwise excused. In this event, a -1 should be used for his grade. A grade of -1 is ignored in the weighted average, so that the student will not be penalized. When the name list is exhausted, the routine then asks if the user wishes to process another subject. If the answer is yes (actually, a Y will do), the process is repeated.

5. Change Grade (code 4). This allows one to change the grade of any student in any subject in a course.

6. List Grade (code 5). This allows one to examine the grades of each student, either collectively or individually. When operated in the Class mode, the grades of all existing subjects of each student are displayed. The user must use the Return key to display each student's grades. When operated in the Individual mode, the user must supply the first few letters of the student's name; the full name is not necessary. That particular student's grades will be displayed. One again enters ZZZ to terminate.

7. Final Grade (code 6). This allows one to calculate the weighted mean of all the scores in all subjects for each student. The user will be asked to supply the weights for each subject. To tailor the program to our needs here at Purdue, the routine also contains a feature which converts the weighted average into letter grades (A, B, C, D and F) according to the standards defined by the user.

All the information is displayed on the screen, and a histogram of the grade distribution in low resolution graphics (see last section) is displayed. One can operate in either Class or Individual mode.

8. Class Average (code 7). This determines the class average and standard deviation of any subject. A histogram may be displayed, if the user wants it, to show the grade distribution.

9. Class List (code 8). This displays the class list in alphabetical order.

10. Exit (code 9). This allows the user to exit the program, and is the recommended manner to exit Grades, for the simple reason that if any of the records in the current course have been modified in any way, an updated version of the files will be put on the diskette before termination. An updated version of the files will not be written on the diskette if the records have not been altered. If a CTRL-C is used to exit Grades instead, all the updated information will be lost.

Grades *has been successfully used by the author for all courses taught in the past two years.*

It should be noted that for the List Grade, Final Grade and Class Average modes, one has the option of requesting hard copies. In this event, it is assumed that a printer exists and and that the printer control board is plugged into slot #3.

Utilities

The following paragraphs very briefly describe the various utilities available to supplement the functions described in the previous section:

1. Return (code 0) allows one to return to the main menu.

2. Initialize (code 1) allows one to perform the necessary initialization for a new course as discussed previously.

3. Copy Data Files (code 2) allows one to make backup copies of the files of a course on another diskette. Note that a second drive is not necessary, as the routine will inform the user when to insert the correct diskette.

4. Name Change (code 3) allows one to change the name of one or more students in a course.

5. Subject Change (code 4) allows one to change the subject title.

6. Subject Sort (code 5) allows one to perform an alphanumeric sort on the subject title. This feature is particularly useful if the subject titles are designated as HW-1, HW-3, QZ-2 and so on, and the grades have been entered at different times of the semester. This utility will allow one to arrange the subjects in sequence to produce an organized report.

7. Delete Subject (code 6) allows one to delete a specific subject from the course. This feature allows one to administer a test, for example, which does not count towards the final grade. One could achieve the same end, of course, by assigning a zero weight for this subject.

8. Delete Course (code 7) allows one to delete a course from a diskette. This may become necessary if the record for a given course is no longer needed, but the disk space is required for another course. One only needs to supply the course designator to have the corresponding files deleted.

Conclusion

Grades can handle up to 50 students in a given course of up to 20 subjects. Some 23 sectors are required on the diskette for each course. Thus, on a 5 1/4" diskette, a total of 17 courses can be accomodated. It should be noted that the program itself occupies about 46 sectors.

The program is extremely easy to use. Whenever the program requests a student's name, one can enter the full name or the first few characters, or ZZZ to terminate. A question should always be answered with a yes or no. Whenever the symbol '--' appears on the screen, it means that the system is waiting for the user to enter a Return to continue.

This feature is included to allow one to proceed at one's own pace. Whenever a histogram is displayed in low resolution graphics, the X-scale is also displayed. Moreover, one can enter a magnification factor to either expand or shrink the Y-scale to produce an optimum display. A magnification factor of zero allows one to exit the graphics mode, and return to the main menu.

Grades has been successfully used by the author for all courses taught in the past two years. Its value lies in its ability to evaluate the class or student's performance rapidly based on the scores obtained in tests, quizzes, exams or homework assignments completed. Further information regarding Grades may be obtained from the author. ☐

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>
> *Robert Maynard Hutchins*

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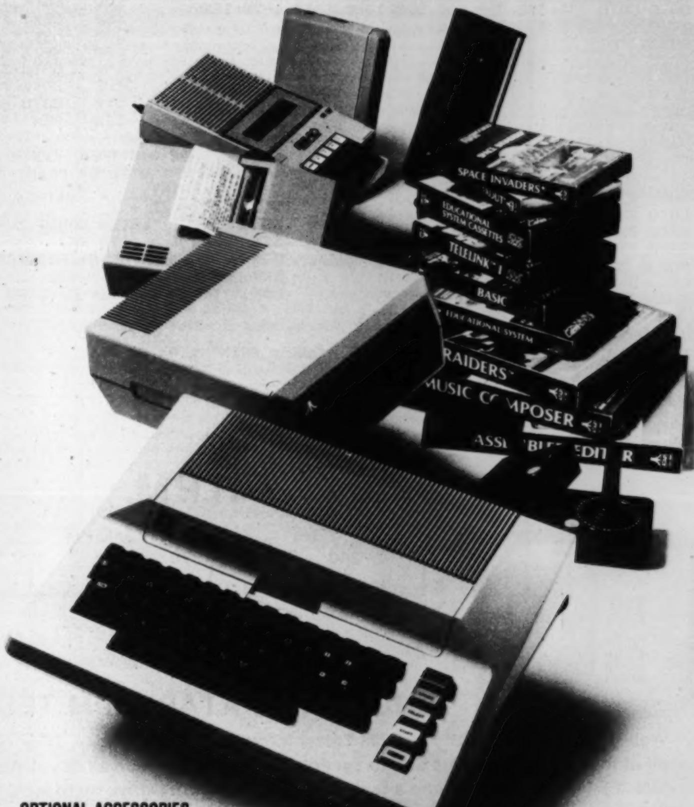

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CIRCLE 109 ON READER SERVICE CARD

Grades, continued...

```
10    DIM NM$(70),SU$(20),SG(70,20),H(20),X(20)
20    D$ =  CHR$ (4):SW = 0: HOME : VTAB 6
25    PQ = 0
30    PRINT  TAB( 6);"GRADES PROGRAM": PRINT : PRINT : PRINT
40    INPUT "COURSE  :     ";F$
50    GOSUB 4170
60    HOME : VTAB 6
65    IF PQ <  > 0 THEN  GOSUB 5600
70    PRINT "CODE"; TAB( 20);"FUNCTION": PRINT
80    PRINT "  0"; TAB( 15);"UTILITIES": PRINT
90    PRINT "  1"; TAB( 15);"ADD STUDENT": PRINT
100   PRINT "  2"; TAB( 15);"DELETE STUDENT": PRINT
110   PRINT "  3"; TAB( 15);"ENTER GRADE": PRINT
120   PRINT "  4"; TAB( 15);"CHANGE GRADE": PRINT
130   PRINT "  5"; TAB( 15);"LIST GRADE": PRINT
140   PRINT "  6"; TAB( 15);"FINAL GRADE": PRINT
150   PRINT "  7"; TAB( 15);"CLASS AVERAGE": PRINT
160   PRINT "  8"; TAB( 15);"CLASS LIST": PRINT
170   PRINT "  9"; TAB( 15);"EXIT PROGRAM": PRINT
180   PRINT : INPUT "ENTER CODE   ";C
190   ON C GOTO 230,370,520,690,920,1080,1330,1670,1800
200   IF C > 9 OR C < 0 THEN 60
210   GOSUB 3610
220   GOTO 60
230   REM --- ADD STUDENT ROUTINE
240   IF SW = 0 THEN  GOSUB 1850
250   HOME : VTAB 6: PRINT "--- ADD MODE"
260   PRINT : PRINT : PRINT
270   INPUT "NAME --    ";Q$
280   IF Q$ = "ZZZ" THEN 320
290   KK = KK + 1
300   NM$(KK) = Q$
310   GOTO 250
320   SG(0,0) = KK
330   SG(0,1) = ZZ
340   GOSUB 3360
350   SW = 2
360   GOTO 60
370   REM  ---   DELETE STUDENT ROUTINE
380   IF SW = 0 THEN  GOSUB 1850
390   HOME : VTAB 6: PRINT "---   DELETE MODE": PRINT : PRINT :
      PRINT
400   GOSUB 2630
410   IF T$ = "ZZZ" THEN 500
420   KK = KK - 1
430   FOR K = II TO KK
440   FOR J = 1 TO 20
450   SG(K,J) = SG(K + 1,J)
460   NEXT J
470   NM$(K) = NM$(K + 1)
480   NEXT K
490   GOTO 390
500   SG(0,0) = KK:SG(0,1) = ZZ:SW = 2
510   GOTO 60
520   REM ---   ENTER GRADE ROUTINE
530   IF SW = 0 THEN  GOSUB 1850
540   HOME : VTAB 6: PRINT "---  ENTER GRADE MODE": PRINT : PRINT
      : PRINT
550   ZZ = ZZ + 1
560   INPUT "ENTER GRADE TYPE --    ";SU$(ZZ)
570   FOR I = 1 TO KK
580   HOME : VTAB 6: PRINT "NAME"; TAB( 20)"GRADE": PRINT : PRINT
590   PRINT NM$(I); TAB( 20);: INPUT SG(I,ZZ)
600   IF SG(I,ZZ) >  - 1 OR SG(I,ZZ) < 101 THEN 620
```

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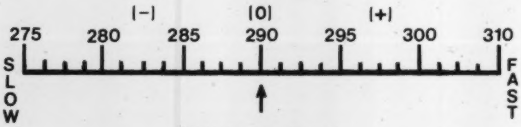

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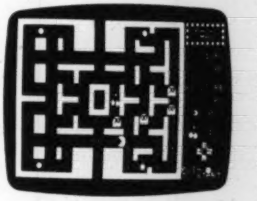

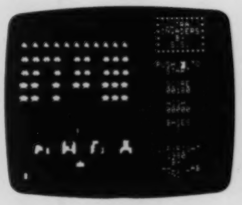

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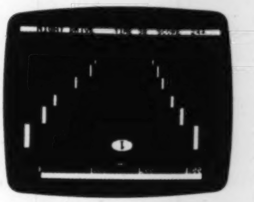

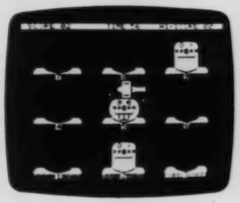

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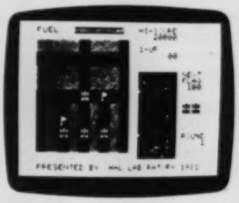

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CIRCLE 133 ON READER SERVICE CARD

Grades, continued...

```
610    PRINT : PRINT : FLASH : PRINT "GRADE NOT BETWEEN 0
        AND 100": NORMAL : INPUT Q$: GOTO 580
620    NEXT I
630    PRINT : PRINT : PRINT
640    INPUT "ANY MORE ?  (Y/N)   ";Q$
650    IF Q$ = "Y" THEN 540
660    SG(0,1) = ZZ
670    SW = 2
680    GOTO 60
690    REM ---   CHANGE GRADE ROUTINE
700    IF SW = 0 THEN  GOSUB 1850
710    HOME : VTAB 6: PRINT "---  CHANGE GRADE MODE": PRINT
       PRINT : PRINT
720    GOSUB 2570
730    PRINT : PRINT : PRINT
740    INPUT "ENTER CODE --   ";C
750    GOSUB 2630
760    IF T$ = "ZZZ" THEN 880
770    CT = 0
780    HOME : VTAB 6
790    PRINT "NAME"; TAB( 15);NM$(II): PRINT
800    PRINT "SUBJECT"; TAB( 15);SU$(C): PRINT
810    PRINT "GRADE"; TAB( 15);SG(II,C): PRINT
820    PRINT : PRINT
830    IF CT ) 0 THEN 750
840    CT = CT + 1
850    INPUT "ENTER CORRECT GRADE  ";SG(II,C)
860    FOR I = 0 TO 500: NEXT I
870    GOTO 780
880    INPUT "ANOTHER SUBJECT ?  (Y/N)   ";Q$
890    IF Q$ = "Y" THEN 710
900    SW = 2
910    GOTO 60
920    REM ---   LIST GRADE MODE
930    IF SW = 0 THEN  GOSUB 1850
940    HOME : VTAB 6: PRINT "---   LIST GRADE MODE": PRINT
       : PRINT
950    INPUT "CLASS OR INDIVIDUAL ?   ";QQ$
960    IF QQ$ = "C" THEN 1015
965    GOSUB 5700
970    HOME : VTAB 6: GOSUB 2630
980    IF T$ = "ZZZ" THEN 60
985    IF PQ = 1 THEN  GOSUB 5500
990    IF II ( ) 0 THEN  GOSUB 2750
1000   INPUT "--   ";Q$
1010   GOTO 970
1015   GOSUB 5700
1020   FOR I = 1 TO KK
1025   IF PQ = 1 THEN  GOSUB 5500
1030   II = I
1040   GOSUB 2750
1045   IF PQ = 1 AND QQ$ = "C" THEN 1060
1050   INPUT "--   ";Q$
1055   IF Q$ = "ZZZ" THEN  GOTO 60
1060   NEXT I
1070   GOTO 60
1080   REM ---   FINAL GRADE ROUTINE
1085   FOR I = 15 TO 20:H(I) = 0: NEXT I
1090   IF SW = 0 THEN  GOSUB 1850
1100   HOME : VTAB 6: PRINT "---  FINAL GRADE MODE": PRINT
       : PRINT
1110   GOSUB 2840
1120   SS = 0
1125   HOME : VTAB 6
1130   PRINT "CODE      SUBJECT       WEIGHT": PRINT
1140   FOR I = 1 TO ZZ
1150   PRINT I,SU$(I); TAB( 30);: INPUT X(I)
1160   SS = SS + X(I)
1165   PRINT
1170   NEXT I
1180   IF SS = 100 THEN 1200
1190   PRINT : PRINT : FLASH : PRINT "WEIGHTS MUST ADD UP
   TO 100": NORMAL : FOR I = 0 TO 2000: NEXT I: GOTO 1120
1200   INPUT "CLASS OR INDIVIDUAL  ?  ";QQ$
1205   GOSUB 5700
1210   FOR I = 1 TO KK
1215   IF PQ = 1 THEN  PRINT : PRINT : PRINT
1220   II = I:T$ = NM$(I)
1230   IF QQ$ ( ) "I" THEN 1260
1240   GOSUB 2630
1250   IF T$ = "ZZZ" THEN 60
1255   IF PQ = 1 THEN  GOSUB 5500
1260   GOSUB 2750
1270   PRINT "-----------------------------------"
1280   GOSUB 2910: PRINT : GOSUB 3530
1285   IF QQ$ ( ) "I" AND PQ = 1 THEN 1300
1290   PRINT : INPUT "--   ";Q$
1295   IF Q$ = "ZZZ" THEN 60
```

```
1300  NEXT I
1305  IF QQ$ <  > "I" THEN  GOSUB 4300
1310  IF QQ$ <  > "I" THEN JJ = 0: FLASH : PRINT "HISTOGRAM
      COMING UP": NORMAL : GOSUB 3040
1320  GOTO 60
1330  REM ---   CLASS AVERAGE ROUTINE
1340  IF SW = 0 THEN  GOSUB 1850
1350  HOME : VTAB 6: PRINT "CLASS AVERAGE MODE": PRINT : PRINT :
      PRINT
1360  GOSUB 2570
1370  INPUT "ENTER CODE --    ";JJ
1380  IF JJ > ZZ OR JJ < 1 THEN  PRINT : PRINT : FLASH : PRINT
      "CODE MUST BE BETWEEN 1 AND  ";ZZ: NORMAL : GOTO 1360
1390  SM = 0:KX = KK:X1 = 1000:X2 =  - 100
1400  FOR I = 1 TO KK
1410  XG = SG(I,JJ)
1420  IF XG =  - 1 THEN KX = KX - 1: GOTO 1460
1430  IF XG > X2 THEN X2 = XG
1440  SM = SM + XG
1450  IF XG < X1 THEN X1 = XG
1460  NEXT I
1470  AV = SM / KX
1480  SM = 0: FOR I = 1 TO KK:XG = SG(I,JJ)
1490  IF XG =  - 1 THEN 1510
1500  SM = SM + (XG - AV) → 2
1510  NEXT I
1520  SM =  SQR (SM / KX)
1530  AV =  INT (AV * 10 + 0.5) / 10:SM =  INT (SM * 10 + 0.5) /
      10
1540  HOME : VTAB 6
1545  GOSUB 5700
1550  PRINT "COURSE :         ";F$: PRINT
1560  PRINT "SUBJECT :        ";SU$(JJ): PRINT
1570  PRINT "# OF STUDENTS :";KX: PRINT
1580  PRINT "--------------------------------": PRINT
1590  PRINT "CLASS AVERAGE  ";AV: PRINT
1600  PRINT "STANDARD DEV.  ";SM: PRINT
1610  PRINT "LOWEST  :        ";X1: PRINT
1620  PRINT "HIGHEST  :       ";X2: PRINT : PRINT : PRINT : INPUT
      "HISTOGRAM  ? (Y/N)  ";Q$
1630  IF Q$ <  > "N" THEN  GOSUB 3040
1640  INPUT "ANOTHER SUBJECT  ? (Y/N)  ";Q$
1650  IF Q$ <  > "N" THEN 1350
1660  GOTO 60
1670  REM ---   CLASS LIST ROUTINE
1680  IF SW = 0 THEN  GOSUB 1850
1690  LI = 0
1700  PRINT : PRINT
1710  FOR I = 1 TO KK
1720  IF LI = 0 THEN  HOME : VTAB 6: PRINT  TAB( 6);"--  CLASS
      LIST OF  ";F$;"  --"
1730  PRINT : PRINT "                ";NM$(I)
1740  LI = LI + 1
1750  IF LI < 10 THEN 1770
1760  LI = 0: INPUT "--   ";Q$
1770  NEXT I
1780  INPUT "--   ";Q$
1790  GOTO 60
1800  REM ---   EXIT PROGRAM ROUTINE
1810  IF SW = 2 THEN  GOSUB 2180
1820  INPUT "ANOTHER COURSE ?  (Y/N)";Q$
1830  IF Q$ = "Y" THEN 20
1840  END

1850  REM ---   READ FILES SUBROUTINE
1860  HOME : VTAB 6: FLASH : PRINT "READING GRADE FILE": NORMAL
1870  PRINT D$;"OPEN ";F$
1880  SW = 1
1890  PRINT D$;"READ ";F$
1900  INPUT SG(0,0)
1910  KK = SG(0,0): PRINT D$;"CLOSE ";F$
1920  PRINT D$;"OPEN ";F$
1930  FOR I = 0 TO KK
1940  FOR J = 0 TO 20
1950  PRINT D$;"READ ";F$
1960  INPUT SG(I,J)
1970  NEXT J
1980  NEXT I
1990  KK = SG(0,0)
2000  ZZ = SG(0,1)
2010  PRINT D$;"CLOSE ";F$
2020  HOME : VTAB 6: FLASH : PRINT "READING NAME FILE": NORMAL
2030  PRINT D$;"OPEN ";N$
2040  FOR I = 1 TO KK
2050  PRINT D$;"READ ";N$
2060  INPUT NM$(I)
2070  NEXT I
2080  PRINT D$;"CLOSE ";N$
```

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CIRCLE 122 ON READER SERVICE CARD

DOSOURCE 3.3
for the Apple II
A source listing of DOS 3.3
Disassembled & commented by Randy Hyde

We used DISASM/65 disassembler program, disassembled Apple's DOS 3.3, and added meaningful lables and comments to create DOSOURCE 3.3, a perfect companion to "Beneath Apple DOS" by Don Worth and Pieter Lechner*. DOSOURCE clearly lists each routine used by Apple DOS.

DOSOURCE is a LISA 2.5 compatible source listing of DOS 3.3. LISA 2.5 owners can load and reassemble DOS at other locations for special applications (such as in a RAM card). DOSOURCE is also a text file that can be loaded into your favorite assembler and converted for use with it. DOSOURCE is also an assembled listing that you can dump to a printer for reference purposes.

With DOSOURCE you can
-> Reassemble DOS 3.3 at different addresses.
-> Utilize several useful routines found within DOS, such as decimal input and output. Many routines within DOS are as useful as routines found within the Apple monitor...only you didn't know about them until now!!
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DISASM/65
by Randy Hyde

DISASM/65 is a LISA compatible 6502 disassembler for the Apple II. DISASM/65 takes unadorned machine code and converts it to an understandable assembly language text file. DISASM/65 allows users to disassemble 6502 instruction codes, HEX data, string data, address data, stack data, and more! DISASM/65 is by far the most powerful 6502 disassembler available for the Apple II. In fact, we used it to disassemble DOS 3.3 for our DOSOURCE package. Over 500 happy users bought DISASM/65 for $24.95 without the source listing (The source listing was available for $35.00 extra). Now, for a limited time, you get both the DISASM/65 program and the source listing for $29.95 (DISASM/65 sources are in a LISA 2.x compatible format). Complete documentation included.

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CIRCLE 210 ON READER SERVICE CARD

Grades, continued...

```
2090  HOME : VTAB 6: FLASH : PRINT "READING SUBJECTS FILE ":
      NORMAL
2100  PRINT D$;"OPEN ";S$
2110  FOR I = 1 TO 20
2120  PRINT D$;"READ ";S$
2130  INPUT SU$(I)
2140  NEXT I
2150  PRINT D$;"CLOSE ";S$
2160  HOME
2170  RETURN

2180  REM ---    WRITE FILE SUBROUTINE
2190  SW = 1
2200  HOME : VTAB 6: FLASH : PRINT "WRITING GRADES FILE": NORMAL
2210  FOR I = KK + 1 TO 70
2220  NM$(I) = "XXX"
2230  FOR J = ZZ + 1 TO 20
2240  SG(I,J) =  - 1
2250  NEXT J
2260  NEXT I
2270  SG(0,0) = KK:SG(0,1) = ZZ
2280  PRINT D$;"OPEN ";F$
2290  PRINT D$;"DELETE ";F$
2300  PRINT D$;"OPEN ";F$
2310  FOR I = 0 TO 70
2320  FOR J = 0 TO 20
2330  PRINT D$;"WRITE ";F$
2340  PRINT SG(I,J)
2350  NEXT J
2360  NEXT I
2370  PRINT D$;"CLOSE ";F$
2380  HOME : VTAB 6: FLASH : PRINT "WRITING NAME FILE ": NORMAL
2390  PRINT D$;"OPEN ";N$
2400  PRINT D$;"DELETE ";N$
2410  PRINT D$;"OPEN ";N$
2420  FOR I = 1 TO 70
2430  PRINT D$;"WRITE ";N$
2440  PRINT NM$(I)
2450  NEXT I
2460  PRINT D$;"CLOSE ";N$
2470  HOME : VTAB 6: FLASH : PRINT "WRITING SUBJECTS FILE":
      NORMAL
2480  PRINT D$;"OPEN ";S$
2490  PRINT D$;"DELETE ";S$
2500  PRINT D$;"OPEN ";S$
2510  FOR I = 1 TO 20
2520  PRINT D$;"WRITE ";S$
2530  PRINT SU$(I)
2540  NEXT I
2550  PRINT D$;"CLOSE ";S$
2560  HOME : RETURN
2570  REM ---    CODE-SUBJECT DISPLAY SUBROUTINE
2580  PRINT "CODE"; TAB( 15);"SUBJECT": PRINT : PRINT
2590  FOR I = 1 TO ZZ
2600  PRINT I; TAB( 15);SU$(I)
2610  NEXT I
2614  PRINT : PRINT : PRINT
2620  RETURN

2630  REM ---    NAME SEARCH SUBROUTINE
2640  REM ---    RETURNS SUBSCRIPT II OR "ZZZ"
2650  II = 0
2660  INPUT "NAME --         ";T$
2670  LX =  LEN (T$)
2675  IF LX = 0 THEN T$ = "ZZZ"
2680  IF T$ = "ZZZ" THEN 2740
2690  FOR I = 1 TO KK
2700  IF  LEFT$ (NM$(I),LX) = T$ THEN II = I: GOTO 2740
2710  NEXT I
2720  PRINT : PRINT : FLASH : PRINT T$;"  NOT IN  ";F$: NORMAL
2730  FOR I = 0 TO 1000: NEXT I: GOTO 2650
2740  RETURN

2750  REM ---    GRADE DISPLAY SUBROUTINE
2760  HOME : VTAB 6
2770  PRINT NM$(II): PRINT : PRINT
2780  PRINT "CODE"; TAB( 10);"SUBJECT"; TAB( 30);"GRADE"
2790  PRINT "-----------------------------------": PRINT
2800  FOR Q = 1 TO ZZ
2810  PRINT Q; TAB( 10);SU$(Q); TAB( 30);SG(II,Q)
2820  NEXT Q
2821  IF PQ = 1 THEN 2830
2822  FOR P0 = 0 TO 5: PRINT : NEXT P0
2830  RETURN

2840  REM ---    LETTER GRADE STANDARDS SUBROUTINE
2850  HOME : VTAB 6: PRINT  TAB( 6);"--  LETTER GRADE STANDARDS
      --": PRINT : PRINT
```

```
2860  INPUT "    A  GRADE --";H(1): PRINT
2870  INPUT "    B  GRADE --";H(2): PRINT
2880  INPUT "    C  GRADE --";H(3): PRINT
2890  INPUT "    D  GRADE --";H(4): PRINT
2900  RETURN

2910  REM ---    FINAL GRADE SUBROUTINE
2920  TS = 0:SZ = 0
2930  FOR J = 1 TO ZZ
2940  IF SG(II,J) =  - 1 THEN SZ = SZ + X(J): GOTO 2960
2950  TS = TS + SG(II,J) * X(J)
2960  NEXT J
2970  FG = TS / 100
2980  IF SZ > 0 THEN FG = FG * 100 / (100 - SZ)
2990  FG =  INT (FG * 100 + 0.5) / 100
3000  PRINT : PRINT : PRINT
3010  PRINT NM$(II); TAB( 20);"AVERAGE :  ";FG
3020  SG(II,0) = FG
3030  RETURN

3040  REM ---    HISTOGRAM SUBROUTINE
3050  MG = 2
3060  FOR I = 1 TO 20:H(I) = 0: NEXT I
3070  FOR I = 1 TO KK
3080  SM = SG(I,JJ)
3090  FU = 95
3100  FOR K = 1 TO 20
3110  LL = 20 - K + 1
3120  IF SM =  - 1 THEN 3160
3130  IF SM >  = FU THEN H(LL) = H(LL) + 1: GOTO 3160
3140  FU = FU - 5
3150  NEXT K
3160  NEXT I
3170  HOME : VTAB 20: GR : COLOR= 0
3180  P = 0:XC = 0
3190  FOR I = 1 TO 20
3200  XC = XC + 1
3210  IF XC > 15 THEN XC = 1
3220  COLOR= XC
3230  PP = 40 - H(I) * MG
3240  IF PP = 40 THEN P = P + 2: GOTO 3300
3250  IF PP < 0 THEN PP = 0
3260  VLIN 39,PP AT P
3270  P = P + 1
3280  VLIN 39,PP AT P
3290  P = P + 1
3300  NEXT I
3310  PRINT "    10  20  30  40  50  60  70  80  90": PRINT
3320  INPUT "MAGNIFICATION FACTOR  ?";MG
3330  IF MG > 0 THEN 3170
3340  TEXT : HOME
3350  RETURN

3360  REM ---    NAME SORT SUBROUTINE
3370  HOME : VTAB 6: FLASH : PRINT "SORTING": NORMAL
3380  F = 0:I = 1
3390  IF NM$(I) < NM$(I + 1) THEN 3490
3400  T$ = NM$(I)
3410  NM$(I) = NM$(I + 1)
3420  NM$(I + 1) = T$
3430  FOR J = 1 TO 20
3440  H(J) = SG(I,J)
3450  SG(I,J) = SG(I + 1,J)
3460  SG(I + 1,J) = H(J)
3470  NEXT J
3480  F = 1
3490  I = I + 1
3500  IF I < KK THEN 3390
3510  IF F = 1 THEN 3380
3520  RETURN

3530  REM   --- LETTER GRADE CONVERSION SUBROUTINE
3540  PRINT : PRINT  TAB( 20);"FINAL GRADE  :  ";
3550  IF FG >  = H(1) THEN H(15) = H(15) + 1: PRINT "A": GOTO 3600
3560  IF FG >  = H(2) THEN H(16) = H(16) + 1: PRINT "B": GOTO 3600
3570  IF FG >  = H(3) THEN H(17) = H(17) + 1: PRINT "C": GOTO 3600
3580  IF FG >  = H(4) THEN H(18) = H(18) + 1: PRINT "D": GOTO 3600
3590  PRINT "F":H(19) = H(19) + 1
3600  RETURN

3610  REM ---   ULTILITIES SUBROUTINE
3620  HOME : VTAB 6: PRINT  TAB( 6);"--- ULTILITIES": PRINT :
      PRINT
3630  PRINT "CODE"; TAB( 15);"UTILITY": PRINT
3640  PRINT "  0"; TAB( 15);"RETURN": PRINT
3650  PRINT "  1"; TAB( 15);"INITIALIZE": PRINT
3660  PRINT "  2"; TAB( 15);"COPY DATA FILES": PRINT
3670  PRINT "  3"; TAB( 15);"NAME CHANGE": PRINT
```

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CIRCLE 267 ON READER SERVICE CARD

Grades, continued...

```
3672  PRINT "  4"; TAB( 15);"SUBJECT CHANGE": PRINT
3674  PRINT "  5"; TAB( 15);"SUBJECT SORT": PRINT
3675  PRINT "  6"; TAB( 15);"DELETE SUBJECT": PRINT
3676  PRINT "  7"; TAB( 15);"DELETE COURSE": PRINT
3680  INPUT "ENTER CODE --     ";C
3690  ON C GOSUB 3710,3920,4120,4500,4700,4900,5100
3700  RETURN

3710  REM ---   INITIALIZATION SUBROUTINE
3720  HOME : VTAB 6: FLASH : PRINT "INITIALIZATION"
      : NORMAL
3730  FOR J = 0 TO 20
3740  SU$(J) = "XXX"
3750  FOR I = 0 TO 70
3760  SG(I,J) =  - 1
3770  NEXT I
3780  NEXT J
3790  FOR I = 0 TO 70
3800  NM$(I) = "XXX"
3810  NEXT I
3820  HOME : VTAB 6: PRINT "INITIAL ENTRY OF CLASS LIST"
3830  KK = 0
3840  INPUT "       NAME ---    ";Q$
3850  IF Q$ = "ZZZ" THEN 3880
3860  KK = KK + 1:NM$(KK) = Q$
3870  GOTO 3840
3880  SG(0,0) = KK:SG(0,1) = 0
3890  GOSUB 3360
3900  SW = 1: GOSUB 2180
3910  RETURN

3920  REM ---   COPY DATA FILE SUBROUTINE
3930  HOME : VTAB 6: PRINT "--- COPY DATA FILE MODE":
      PRINT
3940  SA$ = F$
3950  INPUT "ENTER COURSE --     ";F$
3960  GOSUB 4170
3970  PRINT : PRINT "INSERT DISKETTE": PRINT
3980  GOSUB 4210
3990  INPUT "PRESS RETURN TO READ FILE    ";Q$
4000  GOSUB 1850
4010  HOME : VTAB 6: PRINT "INSERT DISKETTE"
4020  GOSUB 4210
4030  INPUT "PRESS RETURN TO START COPY FILE";Q$
4040  GOSUB 2180
4050  INPUT "ANOTHER COPY OF SAME FILE ?(Y/N)  ";Q$
4060  IF Q$ = "Y" THEN 4010
4070  INPUT "ANOTHER COURSE  ? (Y/N)  ";Q$
4080  IF Q$ = "Y" THEN 3950
4090  F$ = SA$
4100  GOSUB 4170
4110  RETURN

4120  REM  ---   NAME CHANGE SUBROUTINE
4121  IF SW = 0 THEN  GOSUB 1850
4122  HOME : VTAB 6: PRINT "--  NAME CHANGE MODE"
4124  PRINT : PRINT
4126  GOSUB 2630
4128  IF T$ = "ZZZ" THEN 4136
4130  PRINT "OLD NAME IS ";NM$(II)
4132  INPUT "NEW NAME IS ";NM$(II)
4134  GOTO 4122
4136  SW = 2
4138  RETURN

4170  REM ---   SET FILE NAMES SUBROUTINE
4180  S$ = "S" + F$
4190  N$ = "N" + F$
4200  RETURN

4210  REM ---   LIST CATALOG SUBROUTINE
4220  PRINT : PRINT
4230  INPUT "WANT TO SEE CATALOG  ?(Y/N)  ";Q$
4240  IF Q$ (  ) "Y" THEN 4280
4250  HOME
4260  PRINT D$;"CATALOG"
4270  INPUT "--   ";Q$
4280  RETURN

4300  REM ---   FINAL STATISTICS SUBROUTINE
4310  HOME : VTAB 3: PRINT "   FINAL  STATISTICS  "
4320  PRINT : PRINT
4330  PRINT "GRADE"; TAB( 15);"NUMBER"
4340  PRINT "---------------------------"
4350  PRINT "  A"; TAB( 15);H(15): PRINT
4360  PRINT "  B"; TAB( 15);H(16): PRINT
4370  PRINT "  C"; TAB( 15);H(17): PRINT
4380  PRINT "  D"; TAB( 15);H(18): PRINT
```

```
4390  PRINT "  F"; TAB( 15);H(19): PRINT
4400  H(20) = H(15) + H(16) + H(17) + H(18) + H(19)
4410  PRINT "--------------------------"
4420  PRINT "TOTAL"; TAB( 15);H(20): PRINT : PRINT
4430  INPUT "--      ";Q$
4435  IF Q$ = "ZZZ" THEN 60
4440  RETURN

4500  REM : -- SUBJECT CHANGE SUBROUTINE
4502  IF SW = 0 THEN  GOSUB 1850
4506  HOME : VTAB 6
4510  PRINT "SUBJECT CHANGE MODE  --"
4520  GOSUB 2570
4530  INPUT "ENTER CODE  ";C
4540  HOME : VTAB 6
4550  PRINT C,SU$(C): PRINT : PRINT
4560  INPUT "ENTER CORRECT SUBJ TITLE";SU$(C)
4580  HOME : VTAB 6: PRINT C,SU$(C): VTAB 15
4600  SW = 2
4610  INPUT "ANY MORE CHANGES  ?  ";Q$
4620  IF Q$ = "Y" THEN 4506
4630  RETURN

4700  REM  --  SUBJECT SORT UTILITY
4710  IF SW = 0 THEN  GOSUB 1850
4720  HOME : VTAB 6
4730  PRINT "SUBJECT SORT UTILITY"
4740  VTAB 15: FLASH : PRINT "PLEASE BE PATIENT": NORMAL
4750  P = ZZ - 1
4760  F = 0
4770  FOR J = 1 TO P
4780  IF SU$(J) <  = SU$(J + 1) THEN 4840
4790  F = 1
4800  T$ = SU$(J):SU$(J) = SU$(J + 1):SU$(J + 1) = T$
4810  FOR I = 1 TO KK
4820  FG = SG(I,J):SG(I,J) = SG(I,J + 1):SG(I,J + 1) = FG
4830  NEXT I
4840  NEXT J
4844  P = P - 1
4850  IF F = 1 THEN 4760
4855  SW = 2
4860  RETURN

4900  REM
4910  REM  --  DELETE SUBJECT UTILITY
4920  REM
4930  IF SW = 0 THEN  GOSUB 1850
4940  HOME : VTAB 6: PRINT "--DELETE SUBJECT UTILITY --"
4960  GOSUB 2570: INPUT "ENTER CODE  ";C
4970  HOME : VTAB 6: PRINT "DELETING  ";SU$(C)
4980  P = ZZ - 1
4990  FOR J = C TO P:SU$(J) = SU$(J + 1)
5010  FOR I = 1 TO KK:SG(I,J) = SG(I,J + 1)
5040  NEXT I: NEXT J
5045  ZZ = P:SW = 2
5050  VTAB 12: INPUT "ANOTHER SUBJECT  ?";Q$
5060  IF Q$ = "Y" THEN 4940
5080  RETURN

5100  REM
5110  REM  --  DELETE COURSE UTILITY
5120  REM
5130  HOME : VTAB 6: INPUT "COURSE TO BE DELETED  ";F$
5150  VTAB 12: FLASH : INPUT "ARE YOU SURE  ?  ";Q$: NORMAL
5160  IF Q$ >  < "Y" THEN 5196
5165  GOSUB 4170
5170  PRINT D$;"DELETE ";F$
5180  PRINT D$;"DELETE ";S$
5190  PRINT D$;"DELETE ";N$
5192  INPUT "ANY MORE  ? ";Q$
5194  IF Q$ = "Y" THEN 5130
5196  RETURN

5500  REM  --  PRINTER ON SUBROUTINE
5510  PR# 3
5520  PRINT  CHR$ (9);"80N"
5530  PRINT  CHR$ (9);"I"
5540  PRINT  CHR$ (27); CHR$ (66)
5550  PRINT  CHR$ (30)
5560  PRINT : PRINT
5570  RETURN

5600  REM  --  PRINTER OFF ROUTINE
5610  PR# 0
5620  RETURN

5700  REM  --  PRINTER MODE
5710  PRINT : PRINT
5720  INPUT "HARD COPY  ?  ";P$
5730  IF P$ = "Y" THEN PQ = 1: GOSUB 5500
5740  RETURN
```

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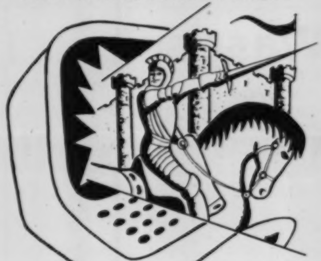

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CIRCLE 179 ON READER SERVICE CARD

Wasps
and
The Impossible Elevator

Michael Orlove

The two programs described here demonstrate two interesting topics in genetics. In the program *Wasps*, the concepts of "altruism" genes and "selfishness" genes are introduced. An altruism gene is any gene which enables, allows, predisposes or causes an animal to give up its own reproduction, survival or parental care in order to augment the reproductive, parental caring, or survival-oriented activities of someone else.

This is not exactly the same thing as "altruism" in the original sense of the word; perhaps the word "beneficence," which means "having good effects on others," would be more appropriate. "Altruism" in the original sense is equivalent to "benevolence," which means "having the will or conscious intention to do good for others." We are, however, stuck with the historical precedent of the use of the word "altruism" in the biological literature.

To read more about it, see Dawkins 1976 and Hamilton 1964. To read about altruism in polistes wasps, see West-Eberhard (1967, 1969), and a forthcoming article by Joan Strassmann (in press).

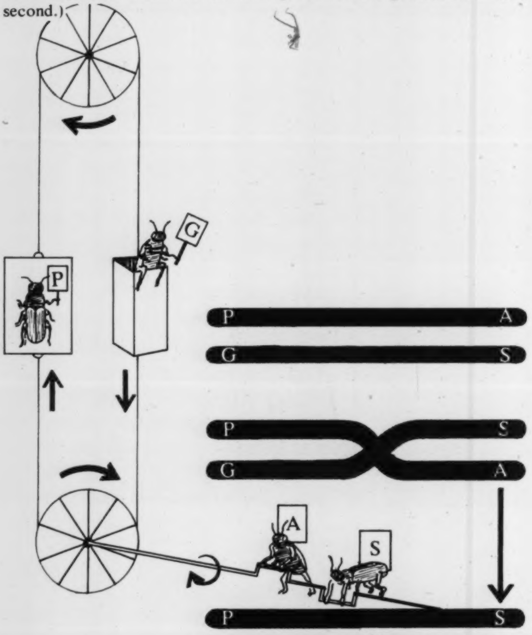
The Impossible Elevator

The Elevator Effect is a phenomenon in evolutionary genetics. It sounds as impossible as the perpetual motion machine, but it really works. The basic process of natural selection occurs when a gene increases in its relative abundance as compared to its alternatives; e.g. green eyes becoming commoner while blue eyes and brown eyes become rarer. An increase of this kind is called an increase in gene frequency. Such increases usually occur due to selection, i.e. when one gene makes the animal fitter in some way. Increases also occur when a useless gene is located next to a useful one. If a gene for purple eyelashes was located on the same chromosome next to a gene for immunity to measles, the purple gene would get a free ride. This is called hitchhiking. Both the rider and the gene providing the ride increase. The elevator effect occurs when the useless gene gets a free ride up (like an elevator car) and its alternative goes down in frequency (like the counterweight) and the gene providing the impetus (like

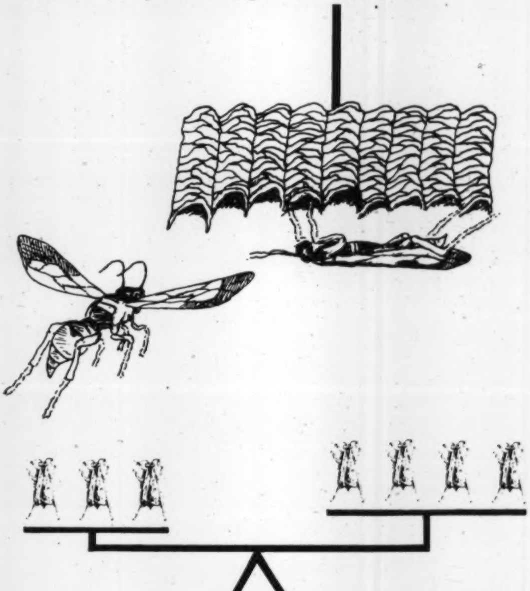
---

Michael Orlove, Dept. of Biology, Case Western Reserve University, Cleveland, OH 44106.

The "Impossible" Elevator. (Time required for one generation = 1/10 second.)



WASPS. Time required for one generation = 30 seconds.)



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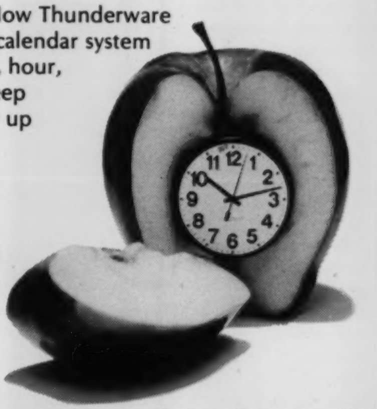

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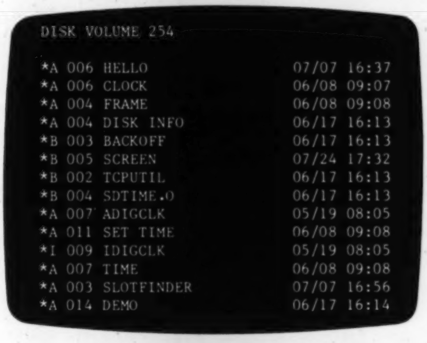

```
DISK VOLUME 254

*A 006 HELLO                07/07 16:37
*A 006 CLOCK                06/08 09:07
*A 004 FRAME                06/08 09:08
*A 004 DISK INFO            06/17 16:13
*B 003 BACKOFF              06/17 16:13
*B 005 SCREEN               07/24 17:32
*B 002 TCPUTIL              06/17 16:13
*B 004 SDTIME.O             06/17 16:13
*A 007 ADIGCLK              05/19 08:05
*A 011 SET TIME             06/08 09:08
*I 009 IDIGCLK              05/19 08:05
*A 007 TIME                 06/08 09:08
*A 003 SLOTFINDER           07/07 16:56
*A 014 DEMO                 06/17 16:14
```

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CIRCLE 276 ON READER SERVICE CARD

the motor) goes nowhere (stays at the same frequency).

The program simulates a population of beetles. In one position on the chromosome is a gene which makes a beetle spend its life rearing twenty nieces and nephews. The alternative gene makes the beetle raise ten of its own kids instead. Since nieces are half as expensive to raise, and also half as related to the rearer, both strategies are equally fit.

Located on the same chromosome is another position with the green-wing gene or the purple-wing gene. Initially, all chromosomes with niece-rearer genes have purple-wing genes and all chromosomes with offspring-rearer genes have green-wing genes. This relationship fades as time passes due to genes crossing over between chromosomes. Thus more and more chromosomes are found each generation with green and niece rearing or purple and kid rearing. Although no gene in this model is more useful than any other, the purple gene increases at the expense of the green. The niece-rearing and offspring-rearing genes stay at the same frequencies.

The proof of this effect is given in a paper in the *Journal of Theoretical Biology* (vol. 90 p. 81-100). To fully appreciate the program, it helps (but isn't necessary) to understand how genes cross over between chromosomes. They do *not* do it like people crossing the street, but by chromosomes exchanging whole segments with one another as in Figures 1 and 2. The places where chromosomes touch to be cut and spliced are called *chiasmata*. Figure 1 shows that an odd number of chiasmata between two chromosomal portions is successful. Figure 2 illustrates how an even number of chiasmata cancel each other out, rather like a double negative.

Thus if the number of units of chromosome length between two portions is 2 and the probability of a successful cross over per unit is 0.1, the net probability of a successful crossover is 0.18, not 0.2. The loss is due to cases where an even number of chiasmata exist.

Finally, I should give some space to the idea of 20 nieces or nephews being as precious as ten offspring. The pedigree diagram will elucidate. (See Diagram 1.)

Diagram 1.

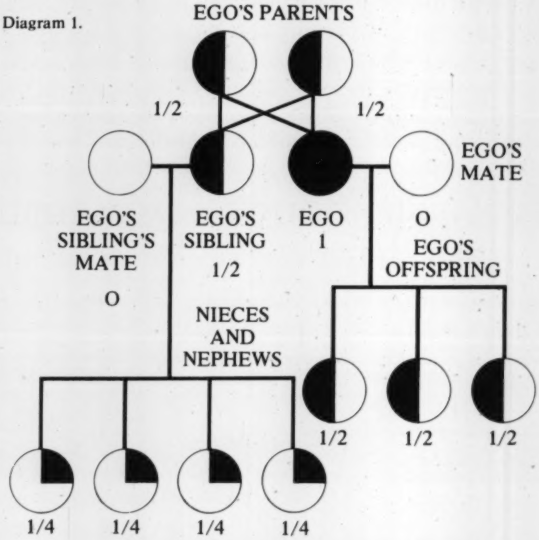


Figure 1.

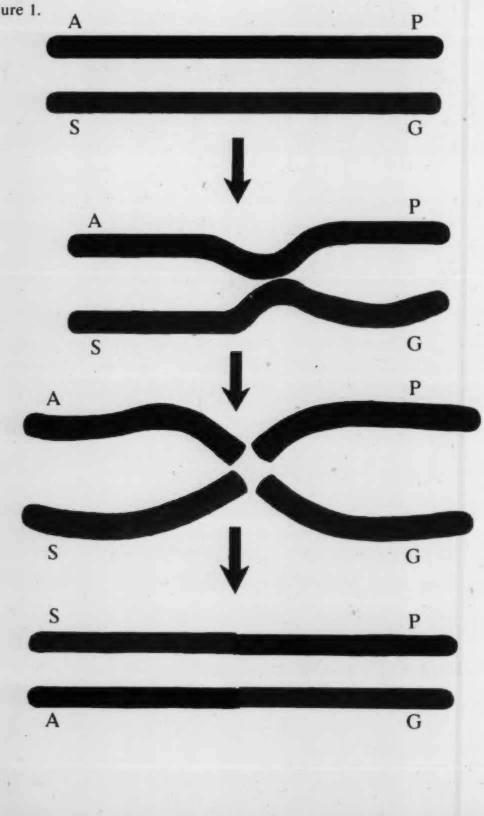
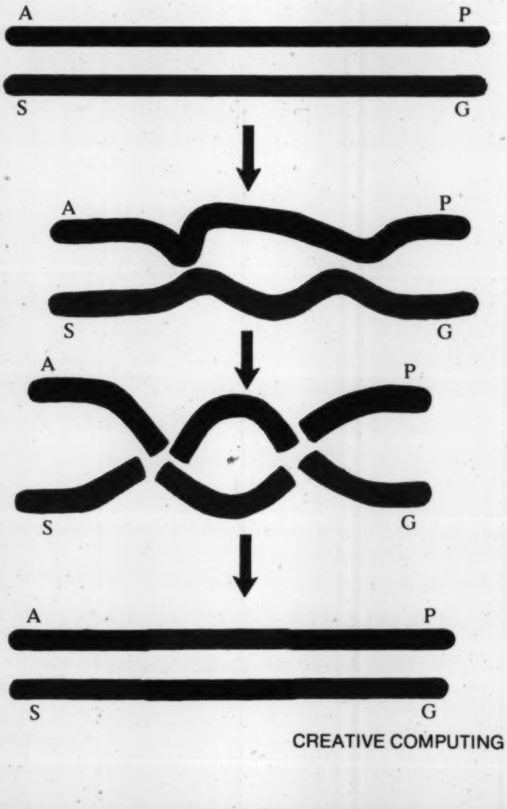
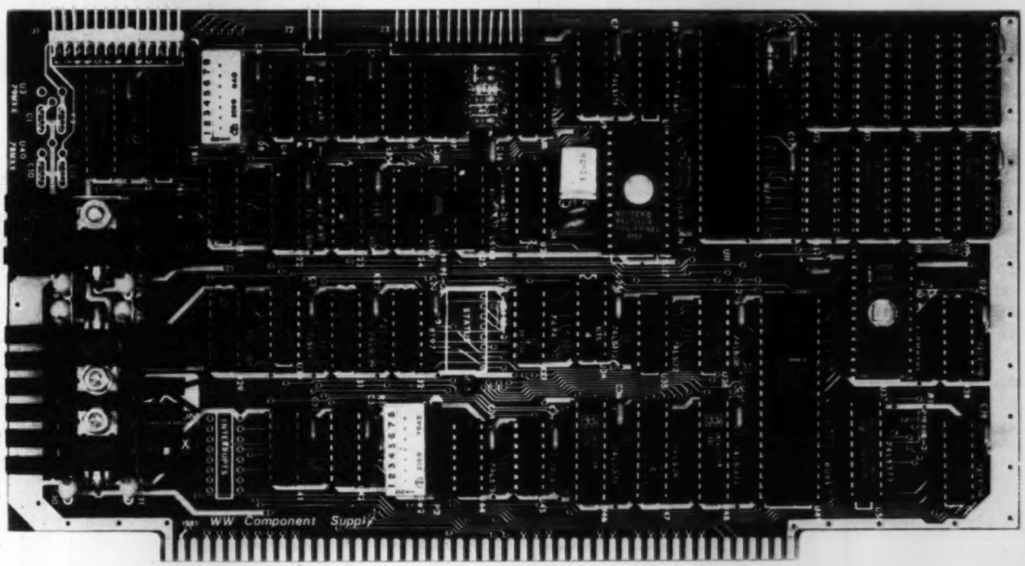


Figure 2.



INTELLIGENT VIDEO I/O FOR S-100 BUS



VIO-X

The VIO-X Video I/O Interface for the S-100 bus provides features equal to most intelligent terminals both efficiently and economically. It allows the use of standard keyboards and CRT monitors in conjunction with existing hardware and software. It will operate with no additional overhead in S-100 systems regardless of processor or system speed.

Through the use of the Intel 8275 CRT controller with an onboard 8085 processor and 4k memory, the VIO-X interface operates independently of the host system and communicates via two ports, thus eliminating the need for host memory space. The screen display rate is effectively 80,000 baud.

The VIO-X1 provides an 80 character by 25 line format (24 lines plus status line) using a 5 × 7 character set in a 7 × 10 dot matrix to display the full upper and lower case ASCII alphanumeric 96 printable character set (including true descenders) with 32 special characters for escape and control characters. An optional 2732 character generator is available which allows an alternate 7 × 10 contiguous graphics character set.

The VIO-X2 also offers an 80 character by 25 line format but uses a 7 × 7 character set in a 9 × 10 dot matrix allowing high-resolution characters to be used. This model also includes expanded firmware for block mode editing and light pen location. Contiguous graphics characters are not supported.

Both models support a full set of control characters and escape sequences, including controls for video attributes, cursor location and positioning, cursor toggle, and scroll speed. An onboard Real Time Clock (RTC) is displayed in the status line and may be read or set from the host system. A checksum test is performed on power-up on the firmware EPROM.

Video attributes provided by the 8275 in the VIO-X include:

- FLASH CHARACTER
- INVERSE CHARACTER
- UNDERLINE CHARACTER or
- ALT. CHARACTER SET
- DIM CHARACTER

The above functions may be toggled together or separately.

The board may be addressed at any port pair in the IEEE 696 (S-100) host system. Status and data ports may be swapped if necessary. Inputs are provided for parallel keyboard and for light pen as well as an output for audio signalling. The interrupt structure is completely compatible with Digital Research's MP/M ®.

Additional features include:

- HIGH SPEED OPERATION
- PORT MAPPED IEEE S-100 INTERFACE
- FORWARD/REVERSE SCROLL or
- PROTECTED SCREEN FIELDS
- CONVERSATIONAL or BLOCK MODE (opt)
- INTERRUPT OPERATION
- CUSTOM CHARACTER SET
- CONTROL CHARACTERS
- ESCAPE CHARACTER COMMANDS
- INTELLIGENT TERMINAL EMULATION
- TWO PAGE SCREEN MEMORY

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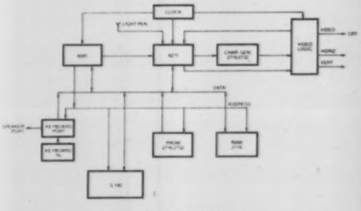
VIO-X2 - 80 × 25 7 × 7 A & T *Conversational & Block Modes*	**$345.00**



VIO-X S-100 I/O INTERFACE

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Elevator, continued...

The pie graphs and fractions indicate the degree to which Ego's genes can be found in each of Ego's relatives. According to modern interpretations of Darwin, animals will attempt to maximize their fitnesses (i.e. evolutionary success) by maximizing their number of descendants. According to Hamilton, this is not always so. Instead, an animal is said to maximize its fitness by maximizing the amount of shaded space (as in the pie graphs). This is how 20 nieces or nephews equals ten offspring.

In wasps, ants, bees, and their allies, males produce sperm asexually. As a result of this, sisters are halfway between ordinary sibs (0.5) and identical twins (1) and come out as 0.75. (See Diagram 2.)

The males are depicted as "half moons" because in this group of insects males have half the number of chromosomes that females do. This is why they reproduce asexually. This pedigree and Hamilton's theory explain many things such as why an animal will raise nieces and nephews instead of offspring, and why it will do so more readily if it is a bee, wasp, or ant. Also, this explains why in bees, wasps, and ants workers are females but males are lazy. In termites, workers and soldiers come in both sexes. The program *Wasps* will show you that, although Hamilton's theory predicts that four nieces or nephews (as opposed to the usual six in other animals) are worth three offspring. This actually only holds when there is no selection and altruism genes are extremely rare or extremely common or when altruism is half dominant. There are two ways to stop selection in the program. (See Diagram 3.)

When you enter "12345," the program recognizes this as a flag and replaces it with whatever value currently exists for number of offspring worth one niece or nephew. □

References

1) Dawkins, R., *The Selfish Gene*, Oxford University Press, Oxford, 1976.

2) Hamilton, W.D. "The Genetical Evolution of Social Behaviour I, II" *Journal of Theoretical Biology* 7, 1-16; p. 17-52.

3) Strassmann, J. "Kin Selection and Satellite Nests in Polistes exclamans" p. 45-58 in *Natural Selection and Social Behavior: Recent Results and Theory*, ed. R. D. Alexander and D. W. Tinkle, Chiron Press, New York, 1981.

4) West, M.J. (1967) *Science*, N.Y. 157, 1584.

5) West Eberhard Misc. Publ. Mus. Zool., Univ., Mich. 140, 1, 1969.

Diagram 2.

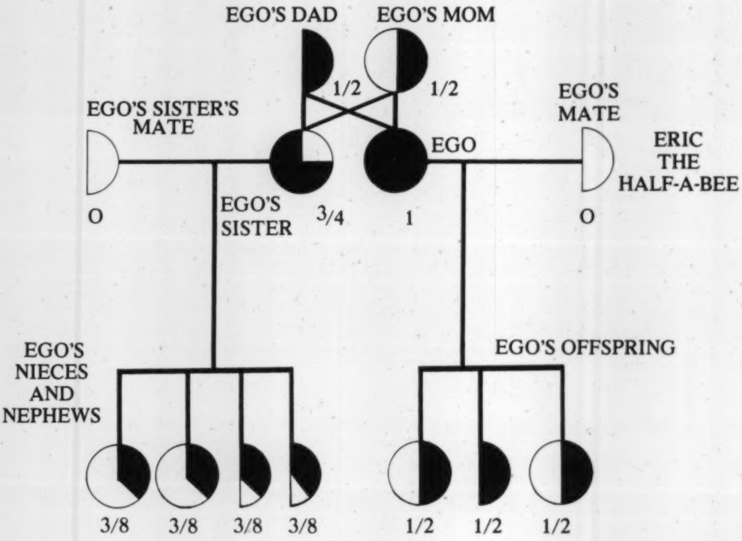

Diagram 3.

DATA ENTERED	method 1	method 2
Number of offspring given up by worker	0	12345
Number of offspring queen has anyway	ANY-THING	ANY-THING
Additional offspring queen has when helped by worker, i.e. nieces and nephews gained by worker	0	1

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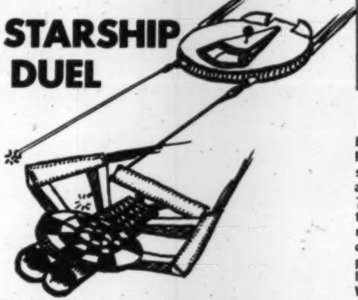
STARSHIP DUEL



By John Kanopa
A two-player space game filled with action, graphics and sound. Each player starts with a fleet of starships and must destroy the opponent's fleet one-by-one. Sound easy? Not only can both ships fly around the screen, but when stopped they disappear. And if you run out of fuel during flight, your ship will explode! Four levels of difficulty will keep you occupied for many an exciting hour.

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Q.S. FORTH

By James Albanese from Quality Software
Using FORTH programming language, you can produce programs that execute almost as fast as machine code but are much easier to write. A compiled language, this version is based on the microcomputer standard FIG-FORTH.

Included modules are: FORTH KERNAL (language for Atari), EXTENSION (added words for more power), EDITOR (to write and modify source code), IOCB (to easily set up I/O operations), and ASSEMBLER (compiles FORTH to assembler).

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By William Robinson from Datasoft
Full-featured, disk-based word processing system for the Atari. With TEXT WIZARD and a suitable printer (e.g. Atari 825/Centronics 737, Epson MX-80), you can manipulate text to your heart's desire. Once you have arrived at a final version, printing commands can be imbedded into the text. Your completed copy can then be printed -- with exactly the format specifications you desire. TEXT WIZARD requires at least one disk drive and 32K of RAM; for longer text files, 48K is desireable.

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DUNGEON CAMPAIGN

By Clardy & Aldrich from Image
A delightful rendition of a Dungeons & Dragons scenario, full of colorful graphics and vivid sound. As you and your stalwart band of adventurers grope around the dungeon the walls in front, back and on both sides of you appear, forming an intricate maze. You must fight -- or buy off -- all manner of beasties in your quest to kill the dragon and escape with gold and jewels. Pterodactyls can lift you up and drop you in unlikely locations, poison gas can blind you, and serpents and spectres track you on your quest. Fun for all ages.

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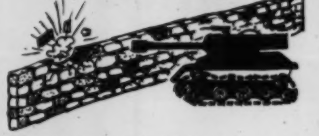
TANK TRAP



By Don Ursem from Quality
Imagine the horror of a sinister tank following you, with the intent of running you down. As you move to escape the ominous form, you can build a wall to fend off the tank or even trap it. This is your plight in TANK TRAP. Played with keyboard or joystick input, you must trap the tank before it runs over you. There are four levels of difficulty, each one adding new complications to your effort.

16K tape...$12.95 32K disk...$14.95

IRIDIS 1

From The Code Works
More than a series of programs, IRIDIS is a continuing series of useful tutorials that will enhance your understanding of the Atari and your programming skills. This first volume includes: CLOCK (a graphic clock with moving hands and chimes), ZAP (a fast-moving chase game), and two graphics demo programs (LOGO and POLYGONS).

The comprehensive booklet accompanying IRIDIS 1 gives complete listings and a line-by-line explanation of each program. Additional features include articles of interest to all Atari users from novice to experienced "hackers." A real buy!

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24K disk...$12.95

3.5
STAR TREK

By Lance Micklus from Adventure Int.
An enhanced version of Micklus' famous STAR TREK III, designed to utilize the Atari's superior graphics. This program was considered best of all the "Treks" reviewed by ANALOG Magazine.

Your mission is to explore all 192 sectors of the Omega VI region of the galaxy. You must inspect all class M planets and destroy any evil Klingons found. STAR TREK 3.5 is a complex strategy game, made very realistic with its graphic displays and sound. Fun and challenging for novice through expert.

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Wasps

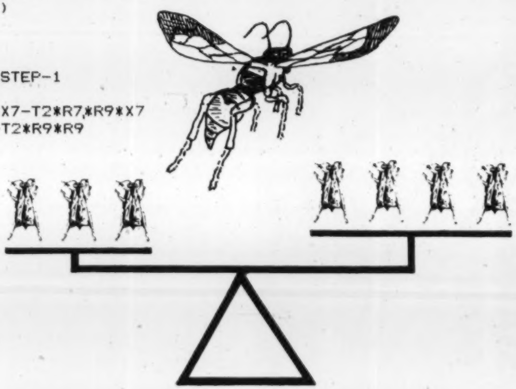
```
1 CLS:PRINT"W A S P S

BY MICHAEL ORLOVE

"
2 PRINT"THIS PROGRAM SIMULATES A POPULATION OF POLISTES WASPS.  EACH
FEMALE FORMS A COLONY OF TWO WITH HER SISTER.  A BRIEF SKIRMISH
OCCURS.  THE WINNER BECOMES THE QUEEN.  THE LOSER EITHER ACTS"
3 PRINT"AS A WORKER FOR HER SISTER OR FLIES OFF TO FOUND A NEST ALONE.
WHICH STRATEGY SHE CHOOSES DEPENDS ON WHETHER SHE HAS ALTRUISM
(NIECE RAISING) OR SELFISHNESS (DAUGHTER RAISING) GENES.
4 PRINT"THE GENE FREQUENCY REFERED TO IN THE DISPLAY IS THAT
FRACTION OF GENE THATS ARE ALTRUISM GENES."
9 INPUT"
<<PRESS ENTER>>";Z:CLS
10 DIM N(8),X(8)
11 INPUT"SELECT DOMINANCE ON A SCALE OF 0 TO 1
0 BEING ALTRUISM DOMINANCE AND 1 BEING SELFISH DOMINANCE";S
14 INPUT"
NOW GIVE ME INITIAL GENE FREQUENCY (A NUMBER BETWEEN 0 AND 1)
";P
15 N(8)=P:N(7)=1-P
16 I0=1
20 O=P
40 FOR I=1TO6
60 N(I)=0
61 X(I)=0
65 NEXT I
70 X(7)=0:X(8)=0
71 INPUT"SEGREGATION RATIO (.5 IS NORMAL)";B2
72 INPUT"HOW MANY KIDS DOES A WORKER LOSE WHEN HELPING";W0
73 INPUT"HIW MANY KIDS DOES THE QUEEN MAKE BY HERSELF";Q0
74 INPUT"HOW MANY ADDITIONAL KIDS DOES THE QUEEN HAVE WHEN
THE WORKER HELPS HER";Q3
75 INPUT" TILL WHAT GENERATION SHOULD I RUN";I7
76 PRINT "GENE FREQ.","GENE FREQ.","OFFSPRING WORTH"," GENERATION"
77 PRINT"IN MALES","(POPULATION)","ONE NIECE"
80 FOR I3=I0 TO I7
90 GOSUB 260
100 W=W0:Q1=Q0:Q2=Q3
110 IF W<>12345 THEN 130
120 W=R
130 REM
140 A9=0
150 S9=0
160 FORI=0TO1:FORJ=0TO1:FORK=0TO1:FORA1=0TO1:FORG=0TO1:FORM=0TO1
170 I8=4*I+2*J+K+8*(1-I)*(1-J)*(1-K)
171 I9=4*A1+2*M+G+8*(1-A1)*(1-M)*(1-G)
180 X1=(W*(S*(I-J)↑2+I*J)+Q1+Q2*(1-(S*(J-K)↑2+J*K)))*N(I8)
185 B3=1-(B2*(I-J)↑2+I*J)
190 A9=A9+X1*B3:S9=S9+X1*(1-B3):X(I9)=X(I9)+X1*ABS((A1-B3)*(M-P)*(G-B3))
200 NEXTM:NEXT G:NEXTA1:NEXT K:NEXT J:NEXT I
210 E=(2*P+O)/3:O=P:P=A9/(A9+S9)
220 PRINT O,E,R,I3
230 D=0
240 FOR I=1TO8:D=D+X(I):NEXTI:FORI=1TO8:N(I)=X(I)/D:X(I)=0:NEXTI
250 NEXT I3
255 I0=I7+1
256 GOTO 72
260 N1=0:N2=0:N3=0:N4=0:D1=0:D2=0:D3=0:D4=0
270 FOR I =0TO1:FORJ=0TO1:FORK=0TO1
280 I8=4*I+2*J+K+8*(1-I)*(1-J)*(1-K)
290 W9=S*(I-J)↑2+I*J:Q9=1-(S*(J-K)↑2+J*K)
300 F=B2*(I-J)↑2+I*J:T=1-F
310 N1=N1+Q9*N(I8)*T:N2=N2+N(I8)*F:N3=N3+Q9*N(I8)*F:N4=N4+N(I8)*T
320 D1=D1+W9*N(I8)*F:D2=D2+N(I8)*T:D3=D3+W9*N(I8)*T:D4=D4+N(I8)*F
330 NEXTK:NEXTJ:NEXTI:R=(N1*N2-N3*N4)/(D1*D2-D3*D4):RETURN
```

Impossible Elevator

```
1 DEFDBL A-H,O-Y
2 CLS:T1=1:T2=2:T5=.5
5 DIM X(80)
10 PRINT CHR$(23);
20 PRINT@450,
30 INPUT"WHAT IS THE INITIAL FREQ. OF THE PURPLE GENE";P
35 CLS:PRINT@475,CHR$(23);
40 INPUT "HOW MANY UNITS OFCHROMOSOME LENGTH DO YOU WANT BETWEEN THE STRATEGY PO
SITION AND THE COLOR POSITION";N
41 L=10
42 IF N<100 THEN 45
43 L=80
45 CLS:PRINT@475,CHR$(23);
50 INPUT"WHAT IS THE PROBABILITY OF A SUCCESSFUL CROSSOVER PER UNIT";S
60 X8=N
70 R8=S
80 GOSUB 500
90 R=R7
95 CLS:PRINT@475,CHR$(23);
100 PRINT"THE NET PROBABILITY OF A SUCCESSFUL CROSSOVER IS ";:PRINT R
105 PRINT CHR$(23);
110 PRINT"THE NUMBER OF OWN KIDS WORTH ONE NIECE OR NEPHEW ( FROM THE VIEW POINT
 OF THE PURPLE GENE ) = ";:PRINT (T1/T2)/(T1-R)
120 P8=(T5*P*P+(T1+T5)*P)/(T1+P)
130 PRINT"THE FREQ. OF THE PURPLE GENE AT TIME=INFINITY IS "
140 PRINTP8
150 P1=P
155 INPUT "HOW MANY GENERATIONS SHOULD SIMULATION LAST";N
160 PRINT"FREQ. OF PURPLE", "GENERATION"
170 FOR I=1 TO N
180 PRINT P1;
181 PRINT I
190 P1=(P1-P8)*(T1-R)+P8
200 NEXT I
499 STOP
500 REM FIND NET CROSSOVER RATE HERE
540 FOR I=1TOL
550 X8=X8/T2
560 NEXT I
570 FORJ=1TOL
580 X8=X8*T2
590 I8=X8
600 X(J)=INT(I8)
610 X8=X8-X(J)
620 NEXT J
630 R7=0
640 R9=R8
650 FORK=LTO1STEP-1
660 X7=X(K)
670 R7=R7+R9*X7-T2*R7*R9*X7
680 R9=T2*R9-T2*R9*R9
690 NEXT K
700 RETURN
```



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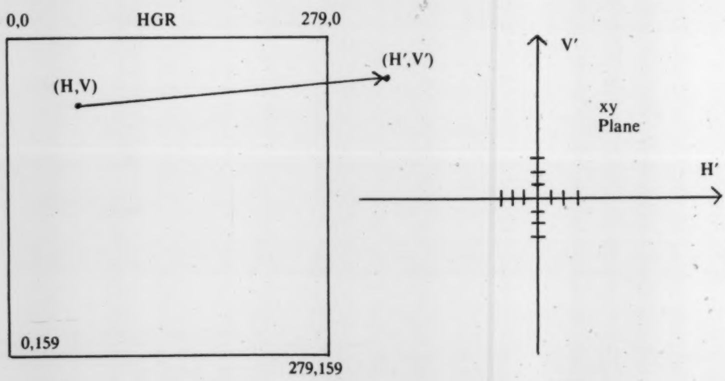
Inequality Tutorial

Ronald Carlson

Since I was teaching mathematics as well as computer programming, one of my first computer applications was a graphing program. Most programming textbooks contain a sample program to plot a function on the printer. With the color and graphic capability of the Apple II, graphs can be greatly enhanced. This article adds another type of graphing program to the list — linear inequality.

Inequality Tutorial is a twofold program. First, as the name implies, the program will tutor an Algebra student in inequalities. The program picks a random inequality, graphs and shades it, and presents a total of five answers from which the user may choose. The second mode is a direct graphing mode. In this mode the user is able to input a linear inequality, such as y < 4x - 17, and the program will graph the line and shade the appropriate side. The inequality is entered as a string rather than a program line for ease of operation.

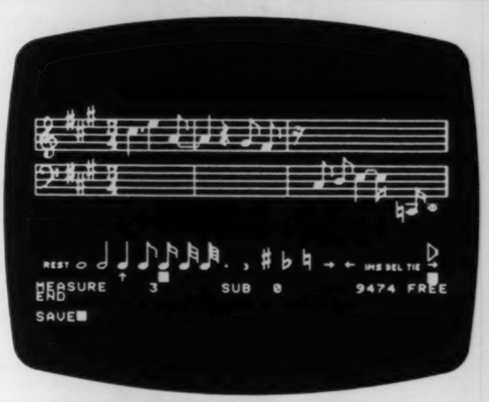
Ronald Carlson, 44825 Kirk Ct, Canton, MI 48187.



Description of Variables

```
A -   Y="A" X + B
280 410 420 420 420 500 570 580

B -   Y=AX + "B"
280 460 480 500 570 580 1150 1150

B$ -   STR$(B)
1150 1170

C$ -   HOLDS THE CORRECT ANSWER
810 870

CA$ -   HOLDS THE LETTER OF THE CORRECT
ANSWER
870 960 980

D$ -   TEMP. VARIABLE
300

F -    F=1 IF >= OR <= IS INVOLVED
280 340 350 410 420 530

F$(*) -    DOTTED OR SOLID LINE
90 90 280

H -    HORIZONTAL POSITION (HGR)
500 500 500 510 510 540 570 580 590

M -    SLOPE IN TUTORIAL PROBLEMS
1060 1070 1070 1080 1090 1090 1100 1120
1130 1130 1130 1140 1150

M$ -    STR$(M)
1070 1080 1090 1130 1140 1160 1160 1160
1170

N -    N/M IN THE SLOPE
1100 1120 1130 1140

P -    FOR-NEXT VARIABLE
430 440 450 460 470 470 470 480

PF -    PF=1 IF THE CORRECT ANSWER HAS
BEEN PRINTED
810 860 870 890

R -    RELATION <:R=0 ; >:R=1
360 370 570 580

R$ -    CONTAINS THE RELATION  (INPUT)
140 150 160 220 260 330 340 360 370 410
410 420 430 440 460 470 480 480 810 920
1170

S$(*) -    <  <=  >  >=
80 80 80 80 1170

T -    RANDOM RELATION IN THE TUTORIAL
1060 1060 1080 1130 1170

T$ -    ANSWER INPUT VARIABLE IN TUTORIAL
950 960

V -    VERTICAL POSITION  (HGR)
500 500 540 570 570 580 580 590 590 600

X -    REAL X VALUE IN THE GRAPH
500 500 570 580 630 630 630 630 630 630
800 800 800 820 840 870 870 890 920 930

Y -    REAL Y VALUE IN THE GRAPH
500 500 570 580

Z -    DUMMY VARIABLE
640 640 1030 1030 1030

Z$(*) -    HOLDS  A,B,C,D IN THE TUTORIAL
100 100 100 100 800 870

ZZ -    DUMMY VARIABLE
640 1030
```

ALF Music Synthesizer



With the ALF software, entry of music is easy, fast and accurate.

The ALF Apple Music Synthesizer (AMS) is an easy to use peripheral which allows you to program music into an Apple II computer using standard musical notation. The ALF kit includes the synthesizer board (plugs into any peripheral slot), exceptional quality software, and an extensive user manual.

Sophisticated Music Entry Program

Sheet music is easily entered using the Apple game paddles. The high-resolution ENTRY program features the familiar music staff with a "menu" of musical items listed beneath it (note lengths, rests, edit commands, accidentals, etc.). One game paddle moves a cursor up and down the music staff and is used to select the note pitch; the second paddle chooses from the menu items (note length, etc.) With the ALF hi-res ENTRY program, you won't have to use cryptic codes to select note parameters.

As you program sheet music with ENTRY, measure bars are inserted automatically (and note values are tied over the bar where necessary). Key signatures are also automatic—you don't have to keep writing in every sharp or flat!

Three monophonic, individual parts can be programmed with each ALF Music Synthesizer. Two boards are required for stereo. A total of three synthesizers can be used simultaneously for a maximum of nine voices. By controling the envelope (or shape) of each voice, many different instrumental sounds can be simulated.

Eight-octave Range

The ALF Music Synthesizer has a pitch range of eight octaves—a wider range than a grand piano. The ALF can also play semitones—"blues notes" or the pitches in between the keyboard notes of a piano. (The pitch range is from 27.5 to 55,000 Hertz, well beyond the limits of human hearing.) Tuning accurancy is virtually perfect within two cents of pitch value.

Every parameter of the ENTRY program can be changed again and again during a musical piece. For example, you can make changes in key, time signature, volume, and timbre (envelope). Parts can be edited at any time, also. Notes can be added or deleted, note length can be changed, as well as pitch, volume, etc.

You can save songs on either cassette or disk, and play them back using either ENTRY or PLAY. The playback speed is adjusted with one of the game paddles, and can be varied during the playback, if you wish to change the overall tempo.

Colorful Playback Display

The ALF Music Synthesizer features a 16-color low-res graphic display during song playback. Each musical part is represented on a stylized piano "keyboard"—the intensity of the note determines the color, and the pitch is shown in relation to "middle C".

The ALF Music Synthesizer requires the use of an external audio amplifier. Stereo programming is possible with the use of two or three synthesizer boards.

The ALF software includes the ENTRY and PLAY programs, sample songs, an introduction to "envelope shaping", and demonstrations of advanced uses of the synthesizer.

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The AM-II uses the same excellent ENTRY and PLAY programs as the more sophisticated ALF Music Synthesizer (AMS); the same hi-res graphic display from which notes are selected with the Apple game paddles (not typed with cryptic codes). All of the conveniences of the ENTRY program apply—easy editing, playback with low-res display, ability to save songs on cassette or disk, etc.

The AM-II has **stereo output** (3 voices in left, 3 voices in the middle, 3 voices in the right).

How can the AM-II offer so much for only $198.00? The two basic differences between the AM-II and the ALF Apple Music Synthesizer (AMS) are pitch accuracy and dynamic range. The AM-II has an accurate pitch range of about six octaves. Pitch values above the treble staff become increasingly inaccurate. Also, the AM-II has a dynamic range of 28db, with 16 different volume levels, (the AMS has a dynamic range of 78db).

The AM-II is manufactured with the same high quality standards as other products from the ALF Corporation. No sacrifice has been made in reliability; the new AM-II is simply a great bargain.

Professional musicians will still want to use the original Apple Music Synthesizer (AMS) for its extended range and volume controls (the AMS has a range of 8 octaves). But for the Apple owner who is interested in music as a hobby, the AM-II is the best music peripheral value available today.

Requires: 16K Apple II or Apple II Plus, cassette or Disk II, and an external audio amplifier (all necessary patch cords are included).

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CIRCLE 280 ON READER SERVICE CARD

Inequality, continued...

```
10  REM ************************
20  REM * INEQUALITY TUTORIAL *
30  REM * APPLE II + FEB 1980 *
40  REM * RON CARLSON          *
50  REM * CANTON,MI 48187      *
60  REM ************************
70  REM
80 S$(0) = "<":S$(1) = "<=":S$(2) = ">":S$(3) = ">="
90 F$(0) = "DOTTED":F$(1) = "SOLID"
100 Z$(1) = "A":Z$(2) = "B":Z$(3) = "C":Z$(4) = "D"
110  REM  VARIOUS STRING CONSTANTS ARE SET
120  HOME : VTAB 21: PRINT "PLEASE ENTER YOUR CHOICE"
130  PRINT "T = TUTORIAL  G=GRAPH   D=DONE";
140  INPUT R$
150  IF R$ = "D" THEN 1200
160  IF R$ <  > "T" THEN 210
170  FLASH : PRINT "1 HASH MARK ON THE AXIS = 10 UNITS": NORMAL
180  GOSUB 720: REM  TUTORIAL
190  GOTO 120
200  REM  GRAPHING SUBROUTINE
210  HOME : VTAB 21: PRINT "EXAMPLE: Y>3X+4  OR Y<=.5X-3 ";
220  INPUT R$
230  VTAB 22
240  PRINT "": REM  CTRL G
250  INVERSE : PRINT "1 HASH MARK ON THE AXIS = 10 UNITS": NORMAL
260  PRINT R$;" THE BLUE AREA IS THE ANSWER"
270  GOSUB 310
280  PRINT "THE LINE  Y= ";A;"X + ";B;" IS ";F$(F)
290  PRINT ""
300  PRINT "HIT ANY KEY TO CONTINUE ";: GET D$: GOTO 110
310  GOSUB 670: REM  CLEAR SCREEN & DRAW AXIS
320  REM  MAIN SUBROUTINE FIND SLOPE,INTERCEPT,RELATION AND GRAPH
330  IF  LEFT$ (R$,1) <  > "Y" THEN 140
340  IF  MID$ (R$,3,1) = "=" THEN F = 1: GOTO 360
350 F = 0
360  IF  MID$ (R$,2,1) = "<" THEN R = 0: GOTO 410
370  IF  MID$ (R$,2,1) = ">" THEN R = 1: GOTO 410
380  REM  THE RELATION IS FOUND
390  PRINT "INVALID RELATION": RETURN
400  REM  FINDING THE VALUES OF A & B
410 A =  VAL ( RIGHT$ (R$, LEN (R$) - 2 - F))
420  IF A = 0 THEN A = 1: IF  MID$ (R$,3 + F,1) = "-" THEN A =  - 1
430  FOR P = 1 TO  LEN (R$)
440  IF  MID$ (R$,P,1) = "X" THEN 460
450  NEXT P
460  IF P >  =  LEN (R$) THEN B = 0: GOTO 490
470  IF  MID$ (R$,P + 1,2) = "+-" THEN P = P + 1
480 B =  VAL ( RIGHT$ (R$, LEN (R$) - P))
490  REM  GRAPHING SECTION
500  FOR V = 0 TO 159:Y = 80 - V:X = (Y - B) / A:H = 140 + X: IF H < 1 THEN
     H = 1: GOTO 550
510  IF H > 278 THEN H = 278: GOTO 550
520  REM  CHECK IF DOTTED OR SOLID LINE
530  IF F = 1 THEN 550
540  HCOLOR= 5: HPLOT H,V
550  HCOLOR= 6
560  REM  SHADE ONE SIDE OF THE LINE OR THE OTHER
570  IF Y > A * (X + 1) + B AND R = 1 THEN  HPLOT H + 1,V TO 279,V: GOTO
     600
580  IF Y < A * (X + 1) + B AND R = 0 THEN  HPLOT H + 1,V TO 279,V: GOTO
     600
590  HPLOT 0,V TO H - 1,V
600  NEXT V
610  REM  AXIS AND HASH MARKS
620  HCOLOR= 4: HPLOT 0,80 TO 279,80: HPLOT 140,0 TO 140,159
630  FOR X = 0 TO 279 STEP 10: HPLOT X,79 TO X,81: NEXT : FOR X = 0 TO 15
     9 STEP 10: HPLOT 138,X TO 142,X: NEXT
640  FOR Z = 1 TO 600:ZZ = Z: NEXT
650  RETURN
660  REM  BLANK THE GRAPHING AREA TO WHITE
670  HGR : HCOLOR= 7: HPLOT 0,0: CALL 62454
680  HCOLOR= 1
690  HPLOT 0,80 TO 279,80: HPLOT 140,0 TO 140,159
700  REM  PUT IN HASH MARKS ON THE AXIS LATER
710  RETURN
720  REM  TUTORIAL
730  GOSUB 1060
740  REM  GET THE PROBLEM
750  GOSUB 310
760  REM  GRAPH IT
770  HOME
780  PRINT ""
790  VTAB 21: PRINT "WHICH LETTER REPRESENTS THE BEST ANSWER"
800  FOR X = 1 TO 4: VTAB 22: HTAB (X - 1) * 20 + 1: PRINT Z$(X);: NEXT
810 C$ = R$:PF = 0
820  FOR X = 1 TO 4: VTAB 22
830  REM  PUT THE RIGHT ANSWER IN A,B,C OR D
840  IF  RND (X) > .25 THEN 890
850  REM  PRINT THE ANSWER ONCE
860  IF PF = 1 THEN 900
870 CA$ = Z$(X): HTAB (X - 1) * 20 + 5: PRINT C$;:PF = 1: GOTO 930
```

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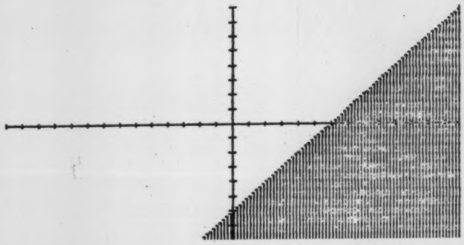
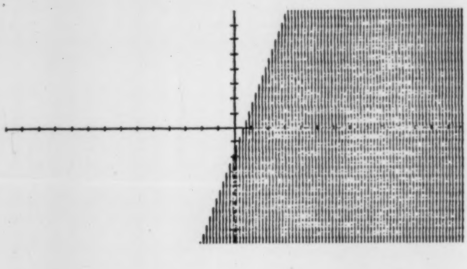
Inequality, continued...



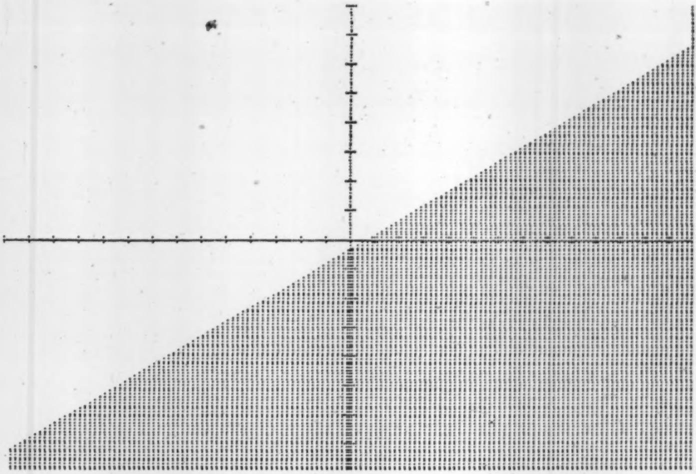
```
PLEASE ENTER YOUR CHOICE
T = TUTORIAL  G=GRAPH   D=DONE?G
EXAMPLE: Y>3X+4  OR Y<=.5X-3 ?Y<X-60

1 HASH MARK ON THE AXIS = 10 UNITS
Y<X-60 THE BLUE AREA IS THE ANSWER
THE LINE  Y= 1X + -60 IS DOTTED
```



```
WHICH LETTER REPRESENTS THE BEST ANSWER
A Y>1X+-42            B   Y>6X+-10
C Y<1.5X+36           D   Y<=4X+-35
E NONE OF THE ABOVE    ANS.?
```

```
880  REM  MAKE SURE THE CORRECT ANSWER IS PRINTED
890  IF X = 4 AND PF = 0 THEN 870
900  GOSUB 1060
910  REM  GO GET ONE OF THE OTHER CHOICES
920  HTAB (X - 1) * 20 + 5: PRINT R$;
930  NEXT X
940  PRINT : PRINT "E  NONE OF THE ABOVE  ANS. ";
950  INPUT T$
960  IF T$ = CA$ THEN 1000
970  PRINT ""
980  PRINT "YOU ARE INCORRECT. THE ANSWER IS";CA$;
990  GOTO 1030
1000  PRINT "YOU ARE CORRECT.";
1010  PRINT ""
1020  REM  STALL
1030  FOR Z = 1 TO 600:ZZ = Z: NEXT Z
1040  RETURN
1050  REM  MAKE UP A PROBLEM
1060 T =  INT ( RND (3) * 4):M =  INT ( RND (T) * 9) + 1
1070  IF  RND (M) > .35 THEN M$ =  STR$ (M): GOTO 1150
1080  IF  RND (T) > .35 THEN M$ =  STR$ ( - M): GOTO 1150
1090  IF M = 1 THEN M$ =  STR$ (M): GOTO 1150
1100 N =  INT ( RND (M) * 4) + 1
1110  REM  PICK A RANDOM A & B IN Y<AX+B
1120  IF M = N THEN 1100
1130  IF  RND (T) > .5 THEN M = N / M:M$ =  STR$ (M): GOTO 1150
1140 M$ =  STR$ ( - N / M)
1150 B =  INT ( RND (M) * 141) - 70:B$ =  STR$ (B)
1160  IF  LEN (M$) >  = 6 THEN M$ =  LEFT$ (M$,6)
1170 R$ = "Y" + S$(T) + M$ + "X+" + B$
1180  REM  PUT THE RANDOM PROBLEM INTO R$ TO USE IN OTHER ROUTINES
1190  RETURN
1200  END
```



```
T = TUTORIAL  G=GRAPH   D=DONE?G
EXAMPLE: Y>3X+4  OR Y<=.5X-3 ?Y<=.5X-3

1 HASH MARK ON THE AXIS = 10 UNITS
Y<=.5X-3 THE BLUE AREA IS THE ANSWER
THE LINE  Y= .5X + -3 IS SOLID
```

Legal entries for the graphing mode are:

Y Relation A x + B
relations < > <= >=
A any real number
B any real number

example: y > .5x + 22 or y < -2x + 35.1

The tutorial mode will produce whole number slopes less than ten and some rational slopes, ones commonly found in high school Algebra. The y intercept ranges from -70 to 70 and all four relations are used.

The program is written in Applesoft Basic and runs on a 32K Apple II+, using high resolution graphics.

The actual graphing starts at line 500. The graphics area on the Apple does not correspond to the xy plane; thus a transformation must be made. I chose to translate the coordinates of Apple screen, (H,V), to the real value on the coordinate plane (H′,V′). The FOR-NEXT loop starts at 0, the top of the screen, and goes to 159, the bottom. The translations H′=H-140 and V′=80-V are used for the x and y values.

Example: (10,10) on the HGR screen is mapped to (-130,70) on the real coordinate plane. I felt that this method would be the easiest to understand and would give the best speed and accuracy.

At line 570 the program decides which side of the line should be shaded. Line 530 indicates if the edge of the inequality is to be dotted line or solid line.

Since the graphing subroutine uses string input, the tutorial subroutine uses random factors for numeric values for the relation, slope and y intercept, and translates them into the same type of string variable as would be found in the input.

Some improvements or variations to this program might include the following:

- variable scale
- ability to select the quadrant
- ability to graph quadratic inequalities
- keeping the false answers close to the correct answer

A list of variables, line numbers and descriptions is included to help with such possible changes. □

The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

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sync

SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

Lots of Games and Applications

Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

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By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where **SYNC** comes in. **SYNC** evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

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CIRCLE 215 ON READER SERVICE CARD

NUMERICAL INTEGRATION ON A TRS-80

Alan Scheidler

Are you intimidated by seemingly difficult integration formulas? Do you have to search through a table of integrals every time you need to calculate the area under the graph of a curve? Are you a student of college calculus? If so, please read on. I think I can show you how to perform even the most difficult integration—and even save time. If you don't know calculus, I believe I can introduce you to an interesting and valuable tool which can be used to solve many practical problems.

Calculus teaches basically two types of operations which can be performed on mathematical expressions. One such operation is called differentiation which can be used to find the slope of a curve at any prescribed point. This article deals with another operation called integration which can be used to find the exact area under a curve between two specified points. Some people spend years studying and perfecting the techniques needed to perform both operations. More often than not, these techniques involve more art than science and require a great deal of memorization.

A Simple Integration Example

Suppose you are asked to determine the area under the curve $y = x^2$ between the x-values of 0 and 3 as shown in Figure 1. If you use the integration techniques prescribed by calculus you can calculate the exact area. But before you old calculus buffs blow the dust off your textbooks, let's analyze the problem a little more closely. Let's apply an old integration principle called the "Approximation Principle" to the problem. The Approximation Principle states that a difficult integration problem may be reduced to one or more very simple problems if allowance is made for inaccuracy. In other words, if you allow yourself a bit of inaccuracy, you can get an approximation of the area under the curve $y = x^2$. For example, you can obtain a very rough estimate of the area by connecting points (0,0) and (3,9) with a straight line (Figure 2). Then by calculating the area of the triangle formed by the three points (0,0), (3,9), and (3,0) you find that the area under the curve is $1/2 \times 3 \times 9 = 13.5$.

Normally this crude estimate is not good enough. The Approximation Principle can be carried a step further to get a better approximation. You can divide the area under the curve into three equally spaced sections as in Figure 3. Each segment is one unit wide. Again connect the points by straight lines. Now calculate the area under each trapezoid. The formula to calculate the area under a trapezoid is:

$$\text{Area} = \frac{(h1 + h2)}{2} \times b$$

where h1 = height of the left side of trapezoid
h2 = height of the right side of trapezoid
b = base of the trapezoid

A difficult integration problem may be reduced to one or more very simple problems if allowance is made for inaccuracy.

In Figure 3, the first area starting on the left is actually a triangle which is merely a special case of a trapezoid with the height of the left side equal to zero. If you proceed to calculate and sum up the individual areas using the above trapezoid formula you will find the area under $y = x^2$ to be:

$$\text{Area} = \frac{(0+1)}{2} \times 1 + \frac{(1+4)}{2} \times 1 + \frac{(4+9)}{2} \times 1$$

$$\text{Area} = 9.5$$

This is a much better approximation—but probably still not good enough for you budding mathematicians. No doubt you've already guessed the exact area is somewhat less than 9.5. This is true because the curve $y = x^2$ always lies on or below the straight lines which connect the top corner points of the trapezoids. The error in our area approximations is equal to the small crescent shaped areas which lie between the oblique trapezoid sides and the curve.

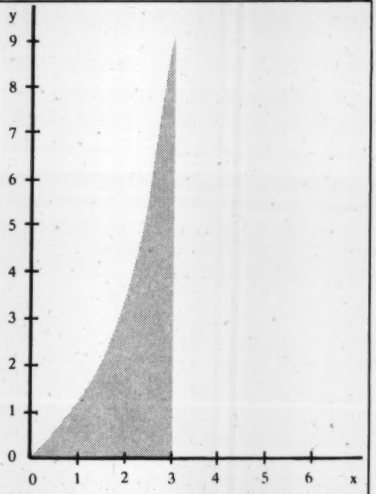

Figure 1. Area under $y = x^2$ between 0 and 3.

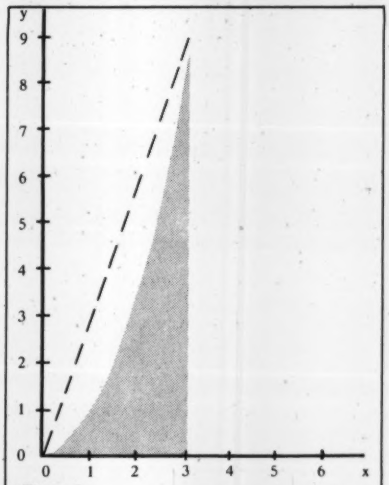

Figure 2.
A very rough estimate of the area under $y = x^2$.

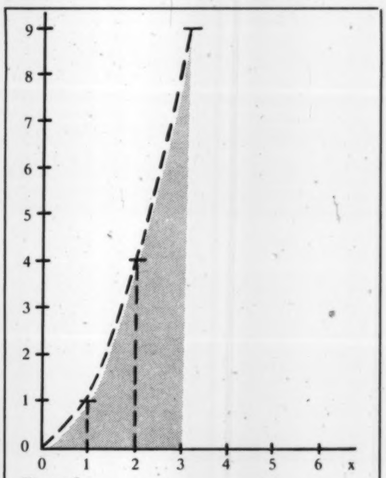

Figure 3.
A better estimate of the area under $y = x^2$.

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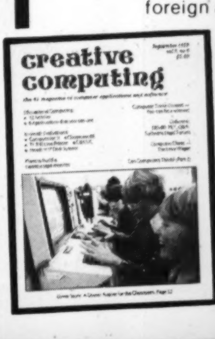

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Before you spend $200 — or $2000 — on a computer system that won't meet your needs, read this.

Straight Talk About Buying A Small Computer

A personal computer. If you don't already have one you're probably thinking about it.

The Plunge

Spending a couple of thousand or even a few hundred dollars is not something you do lightly. Making a decision about which computer to buy is not easy. Deciding about peripherals is even harder. And making intelligent decisions about software is nearly impossible.

But there's a way. *Creative Computing*. It's the magazine with the toughest evaluations in the industry.

In an industry prone to dazzling sales pitches filled with technical doubletalk, some straight advice from an unbiased source could make a lot of difference. Some of the newest computers on the market will be extinct before the first orders are filled; others will achieve astounding popularity. Which would you rather own?

Why Buy One?

The uses of a personal computer would fill several books. Some people have a specific use in mind, others just a general desire to join the computer age. In general, it's advisable to have a good idea of at least one or two things you want a computer to do for you. If you want to analyze stock options, for example, you'll want a computer for which a stock option package is available. If you want to work with color graphics your choice of computer is narrowed to those units with high resolution color output. Even after you've chosen some applications, the choice of a machine isn't easy. Here are a few things that might help.

Hard and Soft

Besides encountering hard and soft sells, you'll also encounter the terms "hardware" and "software." Hardware refers to the electronic parts of a computer system, the circuit boards, chips, peripherals, and other components.

An important part of hardware is memory. The amount of memory a computer has determines how much it can do. Most people start out with systems having 16K (K is short for kilobyte, which means 1024 bytes, or characters like a letter or number) of memory. Later, many people decide to expand their systems, and buy more memory.

Some of the new computers can be purchased with as little as 1K of memory. They can usually be expanded, but the upper limit varies. If you want to play games and write short programs, 16K is adequate. If you want to add a disk drive, or do word processing, you'll probably need 48K or more.

By themselves, these parts are rather dumb. The programs that instruct the computer how to do the more interesting applications (stock option analysis, animation, play a game) are usually contained on magnetic tape or disks. This is software.

Both hardware and software are important. A system with the wrong hardware can be as worthless to you as a sports car would be for a six-member family. Some computers cannot be connected to a printer. Others can't be expanded without a great deal of additional expense. You may not need these extras now, but if you anticipate needing them later, you'll want to select an appropriate system now. And a computer without good software is just an expensive dust catcher.

The Software Cycle

When a computer first hits the market, the only software available will be from the manufacturer. This limits the uses of the machine. As soon as a computer becomes popular, new software pours from dozens of sources. But there is a catch. People won't buy a computer until there is plenty of software available. And vendors won't produce the software until people start buying the computer. Where does this leave you? You can go with one of the established computers, or take a chance on a new machine.

The Newcomers

New computers are appearing almost monthly. One might be right for you. Can anyone tell for sure which will survive? Probably not. But the new machines can be compared against the old. If a computer does everything and more than another does, and costs less, it has a good chance of catching on. If it does less than existing computers, and costs about the same, it is probably doomed.

The Survivors

A few computers currently have the majority of the market. They all have good points and disadvantages. One costs less to start with, but costs more to expand. Another has great graphics but no lowercase letters—a bit of a problem if you want to do word processing. The limitations of any machine can be overcome, for a price. But it is better to get what you want at the start. If you know what you plan to use the computer for, the first step is to determine what that use requires. Do you want to play games? Then you have to decide how important joysticks, paddles, and other controls are. Some computers are supplied with these attachments. Some companies sell these attachments as extras. Do you want to use your own television? Or would you prefer a computer that comes with its own monitor? Will you demand complicated math capabilities from your computer? Certain computers can only handle integers.

Your Choice

Where does this leave you? If you've read this far, you are probably concerned about making the right choice. The following hints could be a good starting place. Take your time, and don't let your first impression of any computer prevent you from taking an honest look at its good and bad points. All computers seem impressive at first. Once you've looked at a few, you'll find that the initial awe is replaced by cold comparison. If you have a specific application in mind, ask to see the computer perform that application. If the salesman starts talking in technical terms while assuring you the machine will do what you want with only a few modifications, find another store. Ask about warranties. Will it be repaired at the store or sent out? Will they provide a loaner during repairs? Is the dealer authorized by the manufacturer?

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This error can never be totally eliminated, but it can be minimized. You've already seen how it can be reduced by calculating three areas instead of one. Well now, let's divide the area into 10 segments and again sum the areas enclosed by the trapezoids. If this sounds like too much work, well, you're right—but this is just the sort of thing that computers were intended for. The Basic program listed in Figure 4 is designed to run on a TRS-80 Level II microcomputer to perform just such a task. This program can also be run on a Level I machine by eliminating line 20 and changing all variable names to just the first letter of each variable name as listed.

If you run this program, you will find that with 10 segments, the estimated area is 9.045. As long as you have the computer handy, try 100 segments. Here the calculated area will be 9.00044. If you are a calculus expert you've no doubt already calculated the exact area to be 9. So you can see the computer result comes very close to the correct value.

This technique for calculating the area under a curve is called Numerical Integration using the Trapezoidal Rule. As we have seen, the Trapezoidal Rule approximates the area under a curve by summing the areas of a specified number of trapezoids. The height of a vertical side of a trapezoid is equal to the y-value which corresponds to particular x-value. Each x-value is found by dividing the integration interval into the desired number of equally spaced segments. The y-value which corresponds to a particular x-value is found by substituting the x-value into the equation of the curve. Thus, for the curve $y = x^2$, the y-value which corresponds to an x-value of 2 is 4. For an x-value of 2.5, the corresponding y-value is 2.5^2 or 6.25, and so on.

The program listed in Figure 4 functions in just this way. First the program asks you to input the upper and lower limits (U and L respectively) which mark the interval over which the integration will be performed. Then it will ask for the number of calculation increments, N, which is actually the number of trapezoids which will be used to approximate the area. With this information, the computer calculates a DX value which is the width of each trapezoid.

The trapezoidal numerical integration program can be used to solve difficult, practical problems.

Then with X starting at the lower limit, N + 1 y-values are computed, incrementing X by DX each time until the upper limit for X has been reached. A(I) is an array used to represent the y-values. Once all of the y-values have been computed, the accumulated area under the curve is calculated by summing the areas of each individual trapezoid using the trapezoid area formula. Then this accumulated area is displayed by the computer. The accumulated area is the result of the numerical integration.

```
10 CLS
20 DIM A( 101 )
30 PRINT "NUMERICAL INTEGRATION USING THE TRAPEZOIDAL RULE"
40 PRINT "ENTER THE FORMULA TO BE INTEGRATED IN LINE 150"
50 INPUT "ENTER THE LOWER LIMIT "; L
60 INPUT "ENTER THE UPPER LIMIT "; U
70 INPUT "ENTER THE NUMBER OF CALCULATION INCREMENTS "; N
80 AREA = 0
90 DX = ( U - L )/N
100 X = L
110 FOR I = 1 TO N + 1
120 '
130 'REPLACE THE NEXT LINE WITH THE FORMULA TO BE INTEGRATED
140 '
150 A( I ) = X * X
160 X = X + DX
170 NEXT I
180 FOR I = 1 TO N
190 AREA = AREA + DX * ( A( I ) + A( I + 1 ))/2
200 NEXT I
210 PRINT "THE AREA UNDER THE CURVE FROM "; L ;" TO "; U
220 PRINT "IS "; AREA
230 PRINT "DO YOU WISH TO CHANGE THE INPUT PARAMETERS ( Y / N ) "
240 INPUT A$
250 IF A$ = "Y" THEN 50
260 IF A$ = "N" THEN END
270 GOTO 210
```

Figure 4.

A Practical Example Problem

The trapezoidal numerical integration program can be used to solve difficult practical problems. Here is an example of the type of problem that can be solved using this method.

You are the engineer in charge of emergency power systems at a nuclear power plant. Your responsibility is to make sure that two 5000 horsepower emergency diesel generators start up to provide standby electrical power upon the loss of both normal and reserve power sources.

Large quantities of diesel fuel must be stored at the plant at all times to ensure that there is enough fuel for even the longest power outages. For maximum safety and reliability, each diesel generator is supplied by its own diesel fuel storage tank. Part of your responsibility is to monitor the oil level in these tanks. Each tank measures 12 feet in diameter by 50 feet in length and is buried lengthwise underground to reduce fire-hazard. The level indicator gauge on one of the tanks indicates an oil level of nine feet. How many gallons of diesel fuel does this represent?

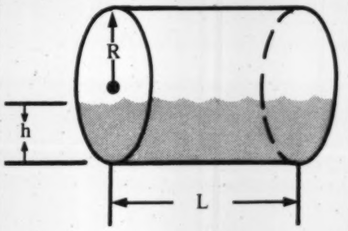

Figure 5. Diesel fuel tank.

The essentials of this problem are diagrammed in Figure 5. To calculate the maximum volume of a tank, you must multiply the cross sectional area of the tank by its length. Thus, the maximum volume of a cylindrical tank is the area of a circle whose diameter is equal to the diameter of the tank multiplied by the length of the tank. This is simple enough, but what about a partially filled tank? Basically the problem is still the same—determine the area of the diesel fuel cross section and multiply by the length. In this case, the diesel fuel cross section will appear to be a circle with its top cut off. This sounds very simple until you actually try to calculate this area.

This problem may appear to be a very difficult problem—and it definitely is difficult if you want absolute accuracy, but let's not forget about the time-honored Approximation Principle. If we can tolerate a small degree of inaccuracy, we can make use of the Trapezoidal rule integration program.

To make use of this program, we must determine the equation of the curve to be

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integrated. You've probably already guessed that the curve to be integrated will be the equation of a circle whose diameter is equal to the diameter of the tank. To simplify the derivation of this equation, I suggest that you place the origin (0,0) at the bottom of the tank with the x-axis pointing straight up as shown in Figure 6. By using this orientation, you can integrate under the circle from a lower limit of 0 to an upper limit equal to the depth of diesel fuel in the tank. This will give you the area of the diesel fuel cross section in the tank. The general equation of the circle which describes the tank is:

$$(x - a)^2 + (y - b)^2 = R^2$$

where $R =$ the radius of the tank
$a = R$
$b = 0$

(the point (a,b) is the coordinates of the center of the circle or tank in this case)

Substituting the values for a and b, the equation becomes:

$$(x - R)^2 + y^2 = R^2$$

Before we use this equation in the integration program, it must be rearranged so that y is isolated on the left side of the equation:

$$y = \sqrt{R^2 - (x - R)^2}$$

You can now use the integration program in the same way you did when you calculated the area under $y = x^2$. Just substitute this new equation in its place. The lower limit of integration will be 0 and the upper limit will be 9, which is the depth of diesel fuel in the tank. This result will be the area under the curve which is described by the above equation.

You have probably guessed that if you perform this integration, you actually get only one-half of the area of the desired cross section. This is because the Trapezoid integration program only calculates the area above the x-axis. We can easily correct this discrepancy by multiplying by 2. Multiplying this result by L, the length of the tank, will give you the volume of diesel fuel in the tank in cubic feet:

$$y = 2L\sqrt{R^2 - (x - R)^2}$$

Now if you want to get real fancy, you can multiply this equation by a factor of 7.4805195 to convert cubic feet to U.S. gallons. The final equation to integrate is then:

$$y = 2L\sqrt{R^2 - (x - R)^2} \times 7.4805195$$

where $L = 50$
$R = 6$
x varies from lower limit to upper limit (0 to 9)

Simply substitute this equation for $y = x^2$ in the integration program, and you're all set. Using a lower limit of 0 and an upper limit of 9 with 20 increments, the calculated volume is 33862 gallons. The exact volume which can be derived very painstakingly by the methods of calculus is 34031 gallons. This amounts to an error of only 0.50%, which is good enough accuracy for most situations. When you actually substitute this equation into the the integration program I suggest that you avoid using the raising-to-a-power function which is available in TRS-80 Basic. This is just a precaution against negative numbers. In other words you cannot raise a negative number to a power, but you can always multiply a negative number by itself. Thus instead of using Y = X ↑ 2, use Y = X * X.

By the way, for all you die-hard calculus addicts, here is the closed form solution for the volume of the diesel fuel in the tank:

$$\text{Volume} = L\left[(h - R)\sqrt{2Rh - h^2} + R^2\text{Arctan}\left(\frac{Q}{\sqrt{1 - Q^2}}\right) + \frac{\pi}{2}R^2\right] \times 7.4805195$$

(gallons)

where $Q = (h - R)/R$
$h =$ diesel fuel depth (ft)
$R =$ radius of tank (ft)
$L =$ length of tank (ft)
all angles are in radians

As you can see, you don't need to be a mathematician to perform complicated integrations, and thanks to the computer, numerical integration can be performed to practically any desired degree of accuracy. You can probably think of many more examples where this technique can be used, but here are a few more:

1. Estimation of the weights of irregularly shaped objects.
2. Estimation of the energy consumed by an electric motor operating under a known but varying load cycle.
3. Estimation of the speed of a space capsule which free-falls from a very high altitude to the surface of the earth. ☐

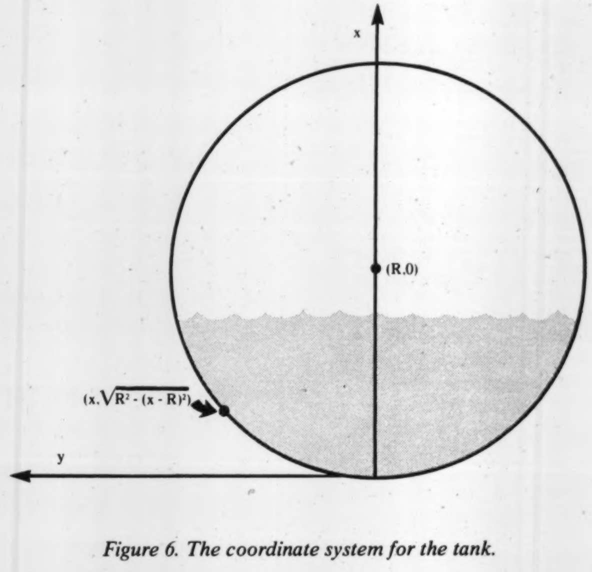

Figure 6. The coordinate system for the tank.

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7 DEPRSL	Straightline depreciation
8 DEPRSY	Sum of the digits depreciation
9 DEPRDB	Declining balance depreciation
10 DEPRDDB	Double declining balance depreciation
11 TAXDEP	Cash flow vs. depreciation tables
12 CHECK2	Prints NEBS checks along with daily register
13 CHECKBK1	Checkbook maintenance program
14 MORTGAGE/A	Mortgage amortization table
15 MULTMON	Computes time needed for money to double, triple, etc.
16 SALVAGE	Determines salvage value of an investment
17 RRVARIN	Rate of return on investment with variable inflows
18 RRCONST	Rate of return on investment with constant inflows
19 EFFECT	Effective interest rate of a loan
20 FVAL	Future value of an investment (compound interest)
21 PVAL	Present value of a future amount
22 LOANPAY	Amount of payment on a loan
23 REGWITH	Equal withdrawals from investment to leave 0 over
24 SIMPDISK	Simple discount analysis
25 DATEVAL	Equivalent & nonequivalent dated values for oblig.
26 ANNUDEF	Present value of deferred annuities
27 MARKUP	% Markup analysis for items
28 SINKFUND	Sinking fund amortization program
29 BONDVAL	Value of a bond
30 DEPLETE	Depletion analysis
31 BLACKSH	Black Scholes options analysis
32 STOCVAL1	Expected return on stock via discounts dividends
33 WARVAL	Value of a warrant
34 BONDVAL2	Value of a bond
35 EPSEST	Estimate of future earnings per share for company
36 BETAALPH	Computes alpha and beta variables for stock
37 SHARPE1	Portfolio selection model-i.e. what stocks to hold
38 OPTWRITE	Option writing computations
39 RTVAL	Value of a right
40 EXPVAL	Expected value analysis
41 BAYES	Bayesian decisions
42 VALPRINF	Value of perfect information
43 VALADINF	Value of additional information
44 UTILITY	Derives utility function
45 SIMPLEX	Linear programming solution by simplex method
46 TRANS	Transportation method for linear programming
47 EOQ	Economic order quantity inventory model
48 QUEUE1	Single server queueing (waiting line) model
49 CVP	Cost-volume-profit analysis
50 CONDPROF	Conditional profit tables
51 OPTLOSS	Opportunity loss tables
52 FQUOQ	Fixed quantity economic order quantity model
NAME	**DESCRIPTION**
53 FQEOWSH	As above but with shortages permitted
54 FQEOQPB	As above but with quantity price breaks
55 QUEUECB	Cost-benefit waiting line analysis
56 NCFANAL	Net cash-flow analysis for simple investment
57 PROFIND	Profitability index of a project
58 CAP1	Cap. Asset Pr. Model analysis of project
59 WACC	Weighted average cost of capital
60 COMPBAL	True rate on loan with compensating bal. required
61 DISCBAL	True rate on discounted loan
62 MERGANAL	Merger analysis computations
63 FINRAT	Financial ratios for a firm
64 NPV	Net present value of project
65 PRINDLAS	Laspeyres price index
66 PRINDPA	Paasche price index
67 SEASIND	Constructs seasonal quantity indices for company
68 TIMETR	Time series analysis linear trend
69 TIMEMOV	Time series analysis moving average trend
70 FUPRINF	Future price estimation with inflation
71 MAILPAC	Mailing list system
72 LETWRT	Letter writing system-links with MAILPAC
73 SORT3	Sorts list of names
74 LABEL1	Shipping label maker
75 LABEL2	Name label maker
76 BUSBUD	DOME business bookkeeping system
77 TIMECLCK	Computes weeks total hours from timeclock info.
78 ACCTPAY	In memory accounts payable system-storage permitted
79 INVOICE	Generate invoice on screen and print on printer
80 INVENT2	In memory inventory control system
81 TELDIR	Computerized telephone directory
82 TIMUSAN	Time use analysis
83 ASSIGN	Use of assignment algorithm for optimal job assign.
84 ACCTREC	In memory accounts receivable system-storage ok
85 TERMSPAY	Compares 3 methods of repayment of loans
86 PAYNET	Computes gross pay required for given net
87 SELLPR	Computes selling price for given after tax amount
88 ARBCOMP	Arbitrage computations
89 DEPRSF	Sinking fund depreciation
90 UPSZONE	Finds UPS zones from zip code
91 ENVELOPE	Types envelope including return address
92 AUTOEXP	Automobile expense analysis
93 INSFILE	Insurance policy file
94 PAYROLL2	In memory payroll system
95 DILANAL	Dilution analysis
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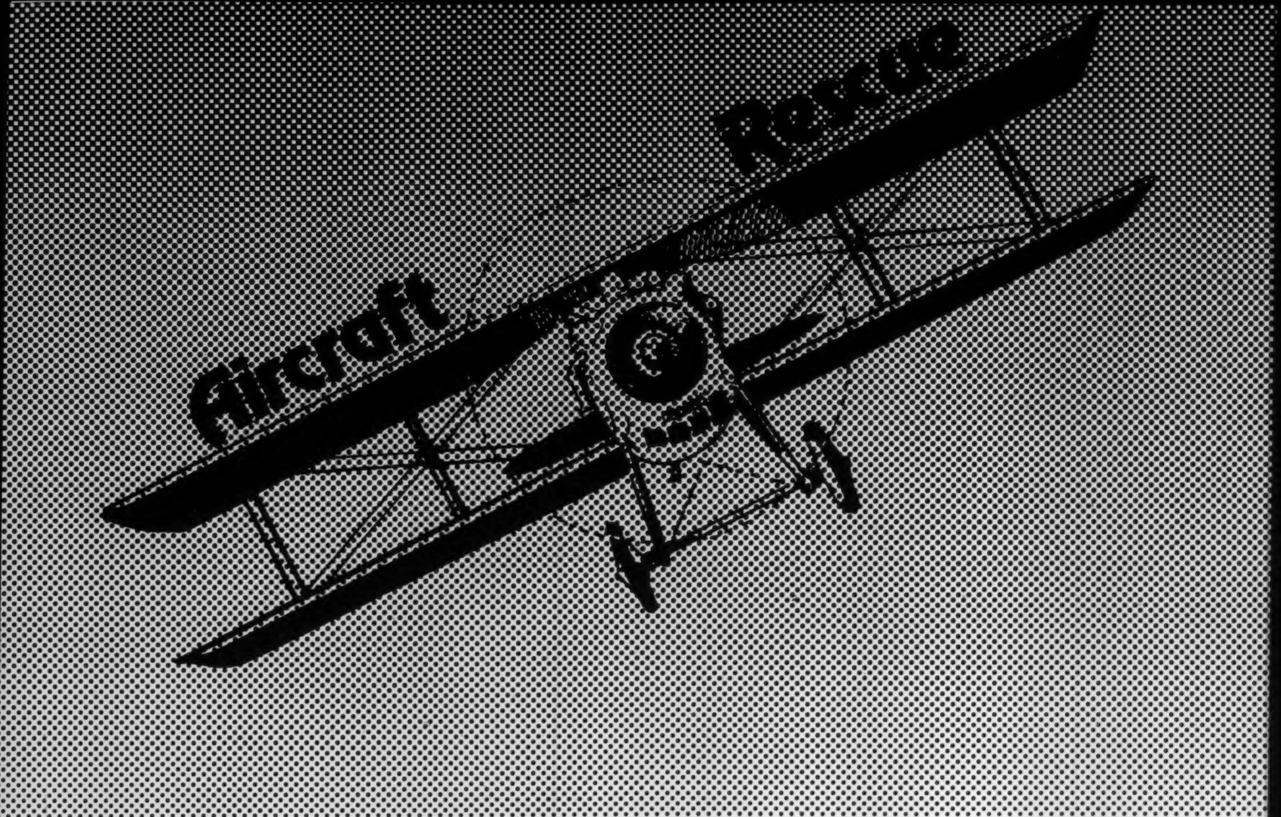
Aircraft Rescue



John Hitchcock

Creative Computing normally isn't the place to discuss the philosophy of teaching physics, but when this philosophy affects the manner in which a computer program is written, then maybe the discussion is permissible.

Having taught physics at the high school level for 18 years, it has become obvious that today's students, while just as intelligent as we ancients, are accustomed to the "entertain me" attitude generated by hours of mindless watching of that electronic guru of the living room.

The television offerings currently available require almost as much participation from the viewer as watching a freshly painted wall dry. A mild "hurrah!" is in order for the microcomputer and the advent of arcade games of the "Invaders" variety. These at least require a certain amount of hand-eye coordination, and the emotional involvement that develops can't be denied.

Adventure type games proceed one step further toward the abstraction that will awaken the creativity latent within a person's mind.

With all this hoopla involving TV screens and interactive game programs, we have attempted to incorporate the microcomputer into our classroom environment. Most of our programs are laboratory analysis programs or the classic "Good job, Joe!" type of computer assisted instruction. While these programs serve a useful function and are enthusiastically used by the students, we are the first to admit that plugging data points into an Apple II isn't nearly as exciting as repelling invaders from outer space.

> ***The object of Aircraft Rescue is to pilot a small plane from Rescue Base to Sick City with a load of emergency medical supplies.***

Our recent programming efforts have been directed toward simulation types of programs in which students are involved in an interactive situation that is fun (even exciting) and yet teaches or reinforces certain physics concepts.

The program described in this article is one such effort which resulted in a student response much more favorable than we ever anticipated. Programming purists will immediately notice the glaring lack of exciting, or even unexciting, computer-generated graphics. This lack is intentional since we wanted the program to maintain a "mind-hand-eye" coordination rather than deteriorate into an exercise in moving the airplane around the screen with a joystick.

The object of Aircraft Rescue is to pilot a small plane from Rescue Base to Sick City with a load of emergency medical supplies before the residents expire from an unknown disease. (One morbid student suggested that the malady afflicting the residents was undoubtedly "physics phever.")

The primary difficulty facing the pilot is an extremely foggy night. Thus, all flying must be done by instruments using a contour map which describes the land over which he must fly. The educational motive of the program is to review the physics concepts of speed, acceleration, vectors, and simple distance-time relationships.

Our expectations were that the program would be entertaining; we didn't expect it to be exciting. Students who are piloting the plane to the rescue usually acquire quite an audience, and considerable copiloting occurs as onlookers analyze the techniques and routes chosen by the pilot. The program approximates real-time, and tension begins to mount as the pilot starts to run out of fuel and time or begins the approach to his landing.

The instructions in the program listing

John Hitchcock, 2330 East Homer Road, Cortland, NY 13045.

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give a fairly complete idea of the problems facing the pilot and the data concerning his plane. Some techniques and hazards are not mentioned in the instructions, but the pilot soon discovers them as the rescue mission progresses.

Some of our more creative students have developed interesting innovations in completing the rescue. They have flown off the chart and around Disaster Desert, perfected take-off and landing techniques which save fuel and time, and have found that they can fly faster if they have a navigator to call out directions. More aggressive flyers have found the quickest way down from high altitudes is to put the plane into a "stall" condition and then pull out just before crashing.

An exciting concept in creating computer programs is that almost all programs have the potential to be improved. This program is no exception, and offers ample opportunity for change, both in the esthetics and the techniques of programming. Several of these possibilities are noted here:

1. Runways could be narrowed or shortened to increase difficulty.
2. Carburetor icing could be included as another hazard.
3. The speed of the plane could be a function of climb/descend rate.
4. Hi-res graphics could be used to create a more authentic looking instrument panel.
5. For those who want a "control the dot on the screen" game, hi-res graphics could be used to display the map and show the actual position of the plane.
6. The game was written without any truly random disasters, but these could easily be included. One possibility is for a hijacking to occur and then the game could turn into an adventure-type game in which the player attempts to make the proper decisions to thwart the hijacker.

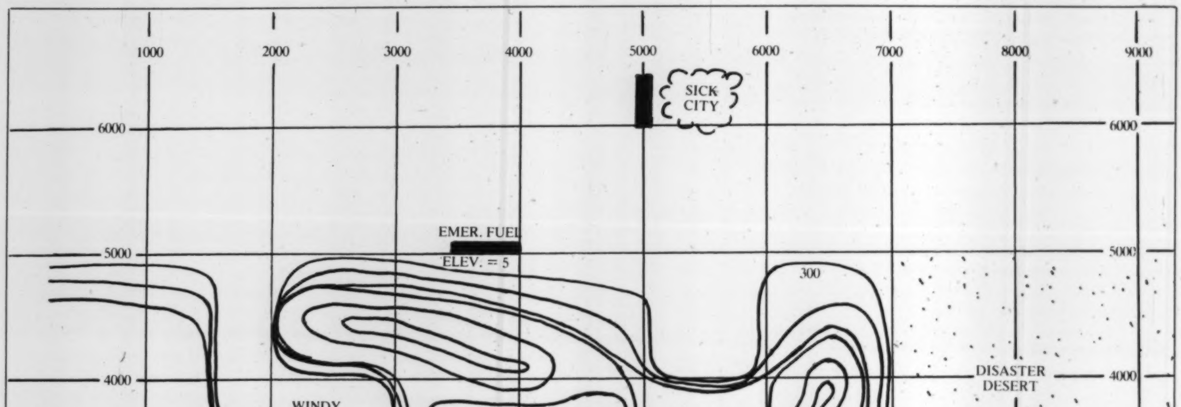
The Program

The program flow is fairly obvious from the listing provided, but certain areas might need explanation for those readers not familiar with Applesoft Basic.

In line 160 X=PEEK (-16287) reads the pushbutton on the game control #0. Pushing this button is the signal that the user wants to change the velocity of the plane. V=PDL(0) sets the value of the game control equal to the velocity (V) and then this value is adjusted by V=V*V1 to allow a maximum speed of 128.

Line 170 is similar to line 160, except the game control is #1 and the variable changed is the heading of the plane. B1 adjusts the value to ranges from 1 to 360 degrees.

In line 180 X=PEEK (-16384) checks



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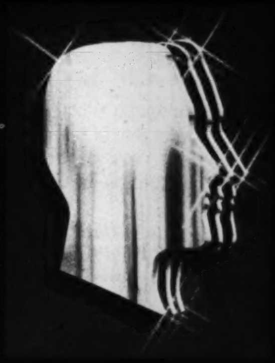

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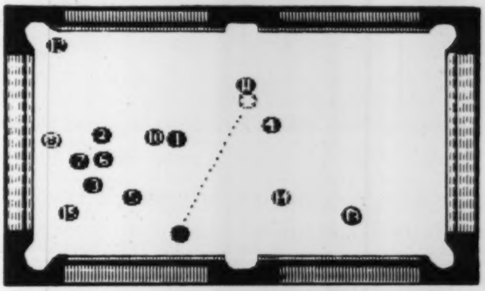

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to see if a key has been pressed on the keyboard. If a key has been pressed, then X is the ASCII value of that key.

Lines 190-200 check to see if the key pressed is a "C" (67) or a "D" (68). If no key has been pressed or the key pressed was not a "C" or "D" the program goes to line 210.

In line 210 POKE -16368,0 resets the keyboard strobe so another character may be read in.

The routine in lines 230-290 toggles the speaker, X=PEEK(-16336), looks at the keyboard to see if a key has been pressed, and if the key pressed is a number between 0 and 9, sets the climb rate, A, to that value.

The routine in lines 310-360 performs the same function as lines 230-290, except the descent rate, D, is determined.

With all the flashy programs on the market today this program provided one unexpected bit of encouragement to us. It showed that even an unsophisticated program written by a novice programmer could provide enjoyment for the user, while accomplishing an educational goal. ☐

Reader Challenge

As the author mentioned, Aircraft Rescue lacks graphics. We view this as a challenge to our readers. Can you come up with a graphic version of the program? If so, we'd like to see it, whether written for the Apple or for another computer. The best version received will be published in these pages, and the author will be paid at our usual rate. All submissions must be in machine-readable form (tape or disk). Address programs to Aircraft Challenge, Creative Computing, 39 E. Hanover Ave., Morris Plains, NJ 07950.

```
1  REM ..........................
     ...
2  REM .......AIRCRAFT RESCUE....
     ...
3  REM ..........................
     ...
4  REM ......BY JOHN HITCHCOCK...
     ...
5  REM ..........................
     ...
6  REM ......HOMER HIGH SCHOOL...
     ...
7  PEM .......HOMER, NEW YORK....
     ...
8  REM ..........................
     ...
9  REM ..........................
     ...
10  HOME : SPEED= 255
12 NX = 1001:NY = 1000:V1 = .5:B1
      = 1.41176:PC = .017453
14 B = 360:V = 0:FF = 12.8:GA = 0

16 OC = 0
20  VTAB 5: PRINT "             AI
     RCRAFT RESCUE
25  VTAB 14: HTAB 1: PRINT "DO YO
     U WANT INSTRUCTIONS? (Y) OR
     (N)";: GET A$
26  IF A$ = "Y" THEN 30
27  IF A$ = "N" THEN 30
28  GOTO 25
30  VTAB 18: HTAB 1: PRINT "WHAT
     LEVEL DIFFICULTY?"
35  PRINT "(1,EASIEST - 3,HARDEST
     )";: GET D$:D =  VAL (D$)
37  IF (D > 0) AND (D < 4) THEN 4
     0
38  GOTO 30
40  IF D = 1 THEN TU = 700:F = 90
     0:OL = 40:WI = 5:WV = 3.3
44  IF D = 2 THEN TU = 500:F = 75
     0:OL = 35:WI = 10:WV = 7.07
48  IF D = 3 THEN TU = 300:F = 60
     0:OL = 30:WI = 20:WV = 14.14

50 RTU = TU:RF = F
60  IF A$ = "N" THEN 120
110  GOSUB 1650: REM ...FOR INSTR
     UCTIONS
120  HOME
130  GOSUB 1360: REM ...DRAW DISP
     LAY BOARD
135 :
136 :
137 :
140  REM ....FLIGHT IN PROGRESS
141 :

150  IF FR = 1 THEN 170: REM ...I
     F FUEL GONE
155 :
156 :
157  REM ...DETERMINE VELOCITY
158 :
160 X =  PEEK ( - 16287): IF X >
     127 THEN V =  PDL (0):V = V *
     V1: GOTO 380
165 :
166 :
167  REM ...DETERMINE HEADING
168 :
170 X =  PEEK ( - 16286): IF X >
     127 THEN B =  PDL (1):B = B *
     B1: GOTO 380
175 :
176 :
177  REM ...DETERMINE CLIMB/DESCE
     ND RATE
178 :
180 X =  PEEK ( - 16384)
190  IF X = 68 THEN 300
200  IF X = 67 THEN 220
210  POKE  - 16368,0: GOTO 380
220 X = 0
230  FOR LC = 1 TO 100
240 X =  PEEK ( - 16336)
250 X =  PEEK ( - 16384)
260  IF (X > 47) AND (X < 58) THEN
     A$ =  CHR$ (X):A =  VAL (A$)
     : POKE  - 16368,0: GOTO 380
270  POKE  - 16368,0
280  NEXT LC
290  GOTO 380
300 X = 0
310  FOR LC = 1 TO 500
320 X =  PEEK ( - 16336)
330 X =  PEEK ( - 16384)
340  IF (X > 47) AND (X < 58) THEN
     A$ =  CHR$ (X):A =  VAL (A$)
     :A =  - A: POKE  - 16368,0: GOTO
     380
350  POKE  - 16368,0
360  NEXT
370 :
371 :
372 :
373 :
380  REM ....DO CALCULATIONS
381 :
382 :
390  REM ...LINES 400-470 CHECK T
     O SEE IF TURN RATE OR VELOCI
     TY CHANGE IS TOO FAST
391 :
392 :
400  IF B = 0 THEN B = 360
410  IF (OB = 360) AND (B < 45) THEN
     470
420  IF SP = 1 THEN 480
430  IF ( ABS (V - OV) > 20) THEN
     1450
440 OV = V
450  IF (OB < 45) AND (B = 360) THEN
     470
460  IF (ALT > 0) AND ( ABS (B
     OB) > 45) THEN 1500
```

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```
470 OB = B
480 T = T + 1
485 :
486 :
487 :
488  REM ...ADJUST FUEL USE
489 :
490 FG = V / FF:F = F - FG: IF F <
     = 0 THEN A =  - 10:FR = 1:F
     = 0
500 ALT = ALT + A
510  IF ALT < 0 THEN ALT = 0
515 :
516 :
517  REM ...ADJUST OXYGEN USE
518 :
520  IF ALT > 900 THEN OL = OL -
     1: IF OL <  = 0 THEN OL = 0:
      IF OL = 0 THEN  GOSUB 1530
535 :
536 :
537  REM ...ACTUAL CALCULATIONS F
     OLLOW
538 :
540  IF B = 0 THEN B = 360
550  IF B < 91 THEN PA = 90 - B:Q
     D = 1
560  IF (B > 90) AND (B < 181) THEN
     PA = B - 90:QD = 2
570  IF (B > 180) AND (B < 271) THEN
     PA = 270 - B:QD = 3
580  IF (B > 270) THEN PA = B - 2
     70:QD = 4
590 PA = PA * PC
600 PX = V *  COS (PA)
610 PY = V *  SIN (PA)
620  IF QD = 2 THEN PY =  - PY
630  IF QD = 3 THEN PY =  - PY:PX
      =  - PX
640  IF QD = 4 THEN PX =  - PX
650 NX =  INT ((NX + PX) + .5)
660 NY =  INT ((NY + PY) + .5)
665 :
666 :
667  REM ...'WINDY GULCH' ROUTE
668 :
670  IF (NX < 3000) AND (NX > 250
     0) AND (NY > 3000) AND (NY <
     3500) THEN W = 1
680  IF (NX < 3000) AND (NX > 250
     0) AND (NY > 3500) AND (NY <
     4000) THEN W = 2
690  IF (NX < 2500) AND (NX > 150
     0) AND (NY > 3500) AND (NY <
     4000) THEN W = 3: IF ALT < 2
     90 THEN 1400
700  IF (NX < 2000) AND (NX > 150
     0) AND (NY > 4000) AND (NY <
     5000) THEN W = 1
710  IF W > 0 THEN SP = 1
715 W$ =  STR$ (WI)
720  IF W = 1 THEN W$ = "N AT " +
     W$:NY = NY - WI: GOTO 767
730  IF W = 2 THEN W$ = "NW AT " +
     W$:NY = NY - WV:NX = NX + WV
     : GOTO 767
740  IF W = 3 THEN W$ = "W AT " +
     W$:NX = NX + WI: GOTO 767
750 W = 0:W$ = "0"
760 SP = 0
765 :
766 :
767  REM ...'QUICK-WAY PASS' ROUT
     E
768  IF (NY > 5000) THEN W = 0:W$
      = "0":SP = 0
770  IF (NX > 5000) AND (NX < 600
     0) AND (NY > 3000) AND (NY <
     4000) THEN 790
780  GOTO 850
790  IF ALT < 901 THEN 1400
800 WD =  INT (20 *  RND (1)) + 1
810 UD =  INT (2 *  RND (1)) + 1
820  IF UD = 1 THEN ALT = ALT + W
     D
830  IF UD = 2 THEN ALT = ALT - W
     D
840  IF ALT < 901 THEN 1400
845 :
846 :
850  REM ...END QUICK WAY
851 :
852 :
853 :
854  REM ...'DISASTER DESERT' ROU
     TE
855 :
856 :
860  IF (NX > 7000) AND (NX < 950
     0) AND (NY > 3000) AND (NY <
     5000) THEN 880
870 SP = 0: GOTO 960
880 RX =  INT (10 *  RND (1)) + 1
     :RY = RX
890 XA =  INT (2 *  RND (1)) + 1:
     YA =  INT (2 *  RND (1)) + 1
900  IF XA = 1 THEN NX = NX + RX
910  IF XA = 2 THEN NX = NX - RX
920  IF YA = 1 THEN NY = NY + RY
930  IF YA = 2 THEN NY = NY - RY
940 B =  INT (360 *  RND (1)) + 1
950 SP = 1
960 :
961 :
962  REM ...CHECK ON CRASH OR SAF
     E LANDING CONDITIONS
963 :
964 :
970  IF (NX < 2500) AND (NY > 250
     0) AND (NY < 3500) THEN 1400
980  IF (NX < 1500) AND (NY > 350
     0) AND (NY < 4500) THEN 1400
990  IF (NY > 3000) AND (NY < 500
     0) AND (NX < 5000) AND (NX >
     3000) THEN 1400
```

```
1000  IF (NY > 4000) AND (NY < 50
     00) AND (NX > 2000) AND (NX <
     3000) THEN 1400
1010  IF (NY > 3000) AND (NY < 50
     00) AND (NX > 6000) AND (NX <
     7000) THEN 1400
1020  IF (NY > 3000) AND (NY < 40
     00) AND (NX > 5000) AND (NX <
     6000) AND (ALT < 900) THEN 1
     400
1040  IF (ALT = 0) AND (NX > 1000
     ) AND (NX < 1500) AND (NY >
     900) AND (NY < 1100) THEN 23
     00
1050  IF (NX > 7000) AND (NX < 75
     00) AND (NY > 2400) AND (NY <
     2600) AND (ALT <  = 275) THEN
     ALT = 275: GOTO 1330
1060  IF (NY > 5000) AND (NY < 51
     50) AND (NX < 4000) AND (NX >
     3500) AND (ALT <  = 5) THEN
     ALT = 5: GOTO 1330
```

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CIRCLE 274 ON READER SERVICE CARD

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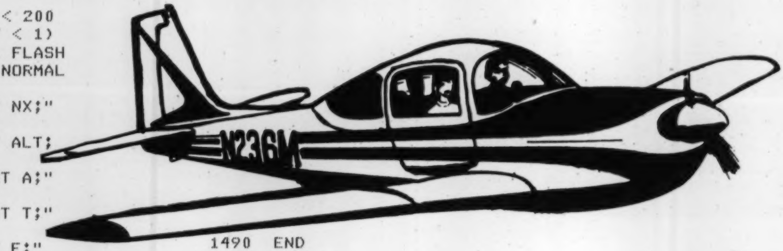
CIRCLE 201 ON READER SERVICE CARD

```
1065  IF (ALT = 0) AND (NY > 6000
     ) AND (NY < 6500) AND (NX >
     4950) AND (NX < 5050) THEN 1
     570
1070 ST = 0
1080  IF (V < 20) AND (ALT > 0) THEN
      PRINT  CHR$ (7)
1090  IF (ALT > 0) AND (V < 15) THEN
     A =  - 30
1100  IF (NX > 6000) AND (ALT < 2
     75) THEN 1400
1110  IF ALT = 0 THEN 1400
1115 :
1116 :
1120  REM ...DISPLAY STATUS
1121 :
1130 V =  INT (V + .5):B =  INT (
     B + .5)
1140 NX =  INT (NX + .5):NY =  INT
     (NY + .5)
1150 F =  INT (F + .5)
1170  VTAB 4: HTAB 6: PRINT V;"
        "
1180  VTAB 4: HTAB 18: PRINT B;"
        "
1190  IF (NX > 9500) OR (NX < 200
     ) OR (NY > 7000) OR (NY < 1)
      THEN  VTAB 4: HTAB 29: FLASH
     : PRINT "OFF CHART  ": NORMAL
     : GOTO 1210
1200  VTAB 4: HTAB 29: PRINT NX;"
     ,";NY;"     "
1210  VTAB 10: HTAB 6: PRINT ALT;
     "     "
1220  VTAB 10: HTAB 18: PRINT A;"
         "
1230  VTAB 10: HTAB 31: PRINT T;"
         "
1240  VTAB 16: HTAB 6: PRINT F;"
        "
1250  VTAB 16: HTAB 18: PRINT W$;
     "      "
1260  VTAB 16: HTAB 31: PRINT OL;
     "  "
1270  IF F = 0 THEN  VTAB 18: HTAB
     15: FLASH : PRINT "FUEL GONE
      ": NORMAL
1280  IF T > TU THEN 2000
1290 LC = 0
1300  FOR Q = 1 TO 200: NEXT Q:Q =
     0
1315  IF OG = 1 THEN 380
1320  GOTO 140
1325 :
1326 :
1330  REM ...REFUEL
1331  IF FR = 1 THEN FR = 0
1332  IF ST = 1 THEN 1350
1335  IF V > 0 THEN  VTAB 18: CALL
      - 958: PRINT "YOU ARE ON TH
     E GROUND BUT STILL MOVING..B
     RING YOUR AIRCRAFT TO A STOP
     .": GOTO 1120
1340 ST = 1
1350  IF V = 0 THEN  VTAB 18: CALL
      - 958: PRINT "YOU ARE NOW R
     EFUELED...RESUME MISSION..":
     F = RF: GOTO 1120
1355  IF V > 0 THEN  VTAB 18: CALL
      - 958: GOTO 1120
1356 :
1357  REM ...DISPLAY INSTRUMENT P
     ANEL
1358 :
1360  VTAB 2: HTAB 5: PRINT "SPEE
     D      HEADING     POSITION
1370  VTAB 8: HTAB 4: PRINT "ALTI
     TUDE    CLM/DES        TIME
1380  VTAB 14: HTAB 6: PRINT "FUE
     L         WIND       OXYGEN LE
     FT"
1390  RETURN
1395 :
1396 :
1397  REM ...CRASH ROUTINE
1398 :
```

```
1400  HOME : FOR X = 1 TO 20: PRINT
     "CRASH" CHR$ (7): NEXT :
1410  VTAB 10: HTAB 20: PRINT "YO
     UR AIRCRAFT IS
1420  VTAB 12: HTAB 20: PRINT "PE
     RMANENTLY PARKED
1430  VTAB 14: HTAB 20: PRINT "AT
      ";NX;",";NY
1440  VTAB 20: HTAB 30: PRINT "BY
     E!": END
1445 :
1446 :
1450  REM ...TOO FAST ROUTINE
1451 :
1452 :
1460  TEXT : HOME
1470  FOR X = 1 TO 15: PRINT "YOU
      DUMBHEAD!!!" CHR$ (7): NEXT

1480  PRINT : PRINT "YOU ACCELERA
     TED TOO FAST AND YOUR PLANE
     SHATTERED ITSELF APART.  YOU
      ARE NOW    SCATTERED HERE,
      THERE, AND EVERYWHERE!"
```



```
1490  END
1495 :
1496 :
1500  REM ...TURN TOO FAST ROUTIN
     E
1501 :
1502 :
1510  TEXT : HOME : PRINT "WHAT A
      KLUTZ PILOT YOU ARE....YOU
           TURNED TOO FAST AND TH
     E WINGS OF YOUR   PLANE TORE
      OFF.......": FOR X = 1 TO 1
     5: PRINT  CHR$ (7): NEXT : PRINT
     "CRASH....CRASH....CRASH....
     CRASH..KLUNK:END
1520  END
1525 :
1526 :
1530  REM ...OXYGEN ROUTINE
1531 :
1532 :
1540  VTAB 20: CALL  - 958
1550  PRINT "WHOOPS! YOUR OXYGEN
     IS ALL USED UP AND  YOUR AIR
     CRAFT IS NOW ON ITS OWN.....
     ..  ...........PERMANENTLY..
     .............
1560 OG = 1: RETURN
1565 :
1566 :
1567 :
1570  REM ....SAFE LANDING
1575  IF GA = 1 THEN 1120
1580  IF V > 0 THEN  VTAB 20: CALL
      - 958: PRINT "YOU ARE ON TH
     E GROUND BUT STILL MOVING. B
     RING YOUR AIRCRAFT TO A STOP
     .": GOTO 1120
1600  VTAB 19: CALL  - 958: PRINT
     "CONGRATULATIONS! YOU HAVE S
     UCCESSFULLY  COMPLETED YOUR
     MISSION.........": FOR X = 1
      TO 1500: NEXT
1610  VTAB 21: FLASH : PRINT "RAD
     IO MESSAGE ARRIVING": NORMAL

1612  VTAB 22: PRINT "TYPE ANY KE
     Y TO RECEIVE.";: GET A$
```

☆ ☆

4MHZ, DOUBLE DENSITY, COLOR & B/W GRAPHICS . . THE LNW80 COMPUTER

LNW RESEARCH

COMPARE THE FEATURES AND PERFORMANCE

FEATURES	LNW80	PMC-80**	TRS-80* MODEL III
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LEVEL II BASIC INTERP.	YES	YES	LEVEL III BASIC
TRS80 MODEL 1 LEVEL II COMPATIBLE	YES	YES	NO
48K BYTES RAM	YES	YES	YES
CASSETTE BAUD RATE	500/1000	500	500/1500
FLOPPY DISK CONTROLLER	SINGLE/ DOUBLE	SINGLE	SINGLE/ DOUBLE
SERIAL RS232 PORT	YES	YES	YES
PRINTER PORT	YES	YES	YES
REAL TIME CLOCK	YES	YES	YES
24 X 80 CHARACTERS	YES	NO	NO
VIDEO MONITOR	YES	YES	YES
UPPER AND LOWER CASE	YES	OPTIONAL	YES
REVERSE VIDEO	YES	NO	NO
KEYBOARD	63 KEY	53 KEY	53 KEY
NUMERIC KEY PAD	YES	NO	YES
B/W GRAPHICS, 128 X 48	YES	YES	YES
HI-RESOLUTION B/W GRAPHICS, 480 X 192	YES	NO	NO
HI-RESOLUTION COLOR GRAPHICS (NTSC), 128 X 192 IN 8 COLORS	YES	NO	NO
HI-RESOLUTION COLOR GRAPHICS (RGB), 384 X 192 IN 8 COLORS	OPTIONAL	NO	NO
WARRANTY	6 MONTHS	90 DAYS	90 DAYS
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LESS MONITOR AND DISK DRIVE	$1,450.00	$1,375.00	---

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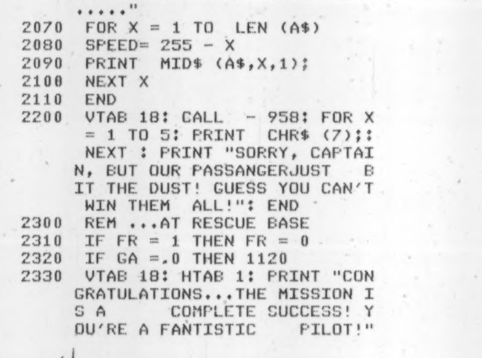
```
1614  HOME : PRINT "SICK CITY COM
     MAND TO RESCUE AIRCRAFT..  W
     E HAVE AN EMERGENCY VICTIM W
     HO NEEDS   IMMEDIATE HOSPITA
     L CARE!"
1616  PRINT "CAN YOU RETURN HIM T
     O RESCUE BASE? THE  STATUS O
     F YOUR AIRCRAFT IS......
1618  PRINT : PRINT "  FUEL REMAI
     NING = ";F
1619  PRINT : PRINT "  OXYGEN LEF
     T    = ";OL
1620  PRINT : PRINT "CAN YOU HELP
     ? (Y) OR (N)";: GET A$
1630  IF A$ = "Y" THEN GA = 1:A =
     0:TU = RTU + T: HOME : GOSUB
     1360: GOTO 1120
1640  PRINT : PRINT "THANK'S BUDD
     Y! YOU'RE COMPASSION IS
     OVERWHELMING.  BUT THANKS FO
     R THE        SUPPLIES ANYWAY.
     ": END
1650  REM ...INSTRUCTIONS
1651 :
1652 :
1660  HOME
1670  PRINT "YOU ARE THE PILOT OF
      A SMALL AIRCRAFT   WHICH IS
      THE ONLY WAY OF DELIVERING
     A   LOAD OF EMERGENCY MEDICA
     L SUPPLIES FROM 'RESCUE BASE
     ' TO 'SICK CITY.'
1680  PRINT
1690  PRINT "TIME IS OF THE ESSEN
     CE...THE SUPPLIES   MUST BE
     DELIVERED WITHIN ";RTU;" TIM
     E UNITS OR THE VILLAGE WILL
     PERISH.
1700  PRINT
1710  PRINT "ONE OTHER IMPORTANT
     FACTOR............ DON'T RU
     N OUT OF FUEL!
1720  PRINT
1730  PRINT "OH, ALMOST FORGOT! I
     T'S ALSO A TOTALLY  FOGGY NI
     GHT....SO ALL YOUR FLIGHT MU
     ST  BE ACCOMPLISHED BY INSTR
     UMENT FLYING.
1740  PRINT : PRINT : PRINT "TYPE
      ANY KEY FOR MORE INSTRUCTIO
     NS ";: GET A$
1750  HOME
1760  PRINT "YOU HAVE A CHOICE OF
      3 POSSIBLE RESCUE  ROUTES.
      BE SURE YOU HAVE OBTAINED A
         CHART TO ASSIST YOU.
1770  PRINT
1780  PRINT " (1) WINDY GULCH THA
     T'S NARROW AND FULL       OF
     TREACHEROUS WIND CURRENTS. O
     NLY       THE BRAVE FLY HERE.

1790  PRINT
1800  PRINT " (2) QUICK-WAY PASS
     WHERE YOU HAVE TO          FLY
      SO HIGH THAT OXYGEN IS NEED
     ED.       BE SURE YOU FLY FAS
     T ENOUGH TO NOT       RUN OUT
     . SOMETIMES THERE ARE
          DANGEROUS DOWNDRAFTS ON
      THIS ROUTE.
1810  PRINT
1820  PRINT " (3) DISASTER DESERT
     ...THEY SAY THAT          UNU
     SUAL THINGS HAPPEN TO YOUR
             PLANE'S CONTROLS ON
      THIS ROUTE.         BUT THE
     RE IS A WAY THROUGH FOR
           THOSE LUCKY ENOUGH TO F
     IND IT!
1830  PRINT : PRINT "TYPE ANY KEY
      FOR MORE INSTRUCTIONS ";: GET
     A$
1840  HOME
1850  PRINT "HERE IS THE TECHNICA
     L DATA ABOUT YOUR   PLANE:"
1860  PRINT
1870  PRINT " 1. SPEED IS CONTROL
     LED BY CONTROL 'A'
1880  PRINT
1890  PRINT " 2. DIRECTION IS CHO
     SEN BY CONTROL 'B'
1900  PRINT
1910  PRINT " 3. SPEEDS LESS THAN
      15 CAUSE YOUR PLANE    TO S
     TALL. A BELL INDICATES YOU A
     RE       APPROACHING THIS CON
     DITION.
1920  PRINT
1930  PRINT " 4. TO CLIMB, TYPE T
     HE LETTER 'C' AND,      WHEN
      THE BUZZING STARTS, TYPE A
           NUMBER THAT IS YOUR
     CLIMB RATE.
1940  PRINT
1950  PRINT " 5. TO DESCEND, TYPE
      'D', AND THEN THE       NUMB
     ER OF YOUR DESCENT RATE.
1960  PRINT : PRINT " 6. OXYGEN R
     EQUIRED ABOVE 900 ALT.
1970  PRINT
1980  PRINT "GOOD LUCK....TYPE AN
     Y KEY TO START.";: GET A$:
1990  RETURN
1995 :
1996 :
2000  REM ...OUT OF TIME
2001 :
2005  IF GA = 1 THEN 2200
2010  VTAB 18: CALL  - 958
2020  FLASH
2030  PRINT "URGENT RADIO MESSAGE
      FROM 'SICK CITY'
2040  FOR X = 1 TO 2000: NEXT X: NORMAL
2050  TEXT : HOME
2060 A$ = "SICK CITY COMMAND TO R
     ESCUE AIRCRAFT..  YOU ARE TO
     O LATE...TOO LATE...TOTAL...
       POPULATION DEAD.....I AM..
     .LAST.......  SURVIVOR....EY
     ES..BLURRY...OOOOAARGH..  WH
     ERE..ARE...YOU...OVER..AND..
     ....."
2070  FOR X = 1 TO  LEN (A$)
2080  SPEED= 255 - X
2090  PRINT  MID$ (A$,X,1);
2100  NEXT X
2110  END
2200  VTAB 18: CALL  - 958: FOR X
     = 1 TO 5: PRINT  CHR$ (7);:
      NEXT : PRINT "SORRY, CAPTAI
     N, BUT OUR PASSANGERJUST   B
     IT THE DUST! GUESS YOU CAN'T
      WIN THEM  ALL!": END
2300  REM ...AT RESCUE BASE
2310  IF FR = 1 THEN FR = 0
2320  IF GA = 0 THEN 1120
2330  VTAB 18: HTAB 1: PRINT "CON
     GRATULATIONS...THE MISSION I
     S A      COMPLETE SUCCESS! Y
     OU'RE A FANTISTIC    PILOT!"
```



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CIRCLE 209 ON READER SERVICE CARD

Practice with Positive and Negative Numbers

ALGEBRA

Z.T. Spaans

Games provide an enjoyable environment for math exercises. "Algebra" trains students to work with positive and negative numbers. Originally it was developed as a board game at the Weizmann-Institute in Israel. The program is written in IAS/RSX Basic V02-01 and runs on a PDP 11/70 in less than 4K.

Possible enhancements to the program might include: adding color to the program; including division; programming a good strategy, if possible, with multiple levels of difficulty.

Notes on the Program

POS(A$,B$,L) looks for the position of B$ in A$ after position L. Example: POS("THE THIEF","TH",2) returns 5. If B$ is not a part of A$, the returned value is 0.

SEG$(A$,N,M) gives the segment of A$ from position M to position N. Example: SEG$("MICKEY MOUSE",4,6) gives "KEY".

Z.T. Spaans, Rhijnuis Feithlann 167, 2533 GD Den Haag.

Sample Run

```
JIM, YOU'RE AT  22 . YOUR CARDS: +4,-3,-1,   *,+
PAT, YOU'RE AT  10 . YOUR CARDS: +1,+1,+1,   +,*
PAT, IT'S YOUR TURN. WHICH OPERATION DO YOU CHOOSE? *
WHICH NUMBER DO YOU USE? 1
4 * 1 = ? 4
EXCELLENT
YOU MOVE  4  FORWARD.
YOU DRAW A -3  AND A +
           1    2    3    4    5    6    7    8    9   10
           2    3    0    0   -2    4    3    0   -1    4
   40    2                                                 3   11
   39    3                                                 0   12
   38   -4                                                -4   13
   37   -1                                                 0  *14
   36   -4                                                -4   15
   35    3                                                 0   16
   34   -2                                                 4   17
   33   -1                                                 1   18
   32    2                                                 4   19
   31   -3                                                 2   20
           2    0   -1    2    3    0    3    1    2   -3
          30   29   28   27   26   25   24   23  *22   21

JIM, YOU'RE AT  22 . YOUR CARDS: +4,-3,-1,   *,+
PAT, YOU'RE AT  14 . YOUR CARDS: -3,+1,+1,   +,+
JIM, IT'S YOUR TURN. WHICH OPERATION DO YOU CHOOSE? *
WHICH NUMBER DO YOU USE? 4
2 * 4 = ? 8
GOOD!
YOU MOVE  8  FORWARD.
YOU DRAW A  1  AND A -
           1    2    3    4    5    6    7    8    9   10
           2    3    0    0   -2    4    3    0   -1    4
   40    2                                                 3   11
   39    3                                                 0   12
   38   -4                                                -4   13
   37   -1                                                 0  *14
   36   -4                                                -4   15
   35    3                                                 0   16
   34   -2                                                 4   17
   33   -1                                                 1   18
   32    2                                                 4   19
   31   -3                                                 2   20
           2    0   -1    2    3    0    3    1    2   -3
         *30   29   28   27   26   25   24   23   22   21

JIM, YOU'RE AT  30 . YOUR CARDS: +1,-3,-1,   -,+
PAT, YOU'RE AT  14 . YOUR CARDS: -3,+1,+1,   +,+
PAT, IT'S YOUR TURN. WHICH OPERATION DO YOU CHOOSE? +
WHICH NUMBER DO YOU USE? -3
0 + -3 = ? -3
WOW!!!
YOU GO  3  BACK! THAT'S A PITY.
YOU DRAW A -1  AND A +
           1    2    3    4    5    6    7    8    9   10
           2    3    0    0   -2    4    3    0   -1    4
   40    2                                                 3  *11
   39    3                                                 0   12
   38   -4                                                -4   13
   37   -1                                                 0   14
   36   -4                                                -4   15
   35    3                                                 0   16
   34   -2                                                 4   17
   33   -1                                                 1   18
   32    2                                                 4   19
   31   -3                                                 2   20
           2    0   -1    2    3    0    3    1    2   -3
         *30   29   28   27   26   25   24   23   22   21
```

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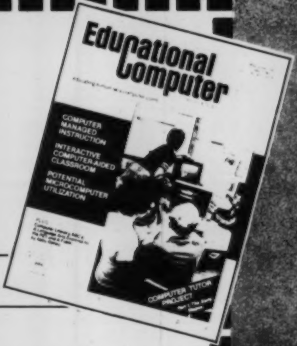
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CIRCLE 185 ON READER SERVICE CARD

Algebra Program Listing

```
10 REM ALGEBRA1, IDEA WEIZMANN INSTITUTE TEL AVIV, PROGRAM BY TEUN SPAANS
20 REM
30 REM N      = NUMBER OF PLAYERS
40 REM N$()  = NAMES   ,,   ,,
50 REM C%(,) = CARDS   ,,   ,,
60 REM P%()  = PAWNS   ,,   ,,
70 REM B%()  = BOARD.
80 REM
90 DIM N$(4),C%(4,4),P%(4),B%(40)
99 REM
100 REM ===> INITIALISATION                \ RANDOMIZE \ C$="0123456789"
101 REM
110 PRINT "SHOULD I PRINT INSTRUCTIONS"; \ INPUT I$ \ IF I$="Y" THEN 1800
120 IF I$="YES" THEN 1800
130 IF I$="NO" THEN 170
140 IF I$="N" THEN 170
150 PRINT "PLEASE ANSWER WITH YES OR NO. I'M JUST A DUMB COMPUTER, YOU KNOW."
160 GO TO 110
170 T$="HOW MANY PLAYERS " \ GOSUB 1500 \ N=L%-1
180 IF N<1 THEN PRINT "AT LEAST 2 PLAYERS." \ GO TO 170
190 IF N>4 THEN PRINT "NO MORE THAN 5 PLAYERS ALLOWED." \ GO TO 170
200 FOR I=0 TO N \ PRINT "PLAYER "I+1", PLEASE TELL ME YOUR NAME"; \ INPUT N$(I)
210 P%(I)=1 \ IF N$(I)="" THEN 200
220 FOR J=0 TO 4 \ C%(I,J)=(4-J)*RND+1 \ NEXT J \ NEXT I
230 FOR I=1 TO 40 \ B%(I)=-5+RND*10 \ NEXT I \ O$="+-*"
239 REM
240 REM ===> INPUT
241 REM
250 FOR P=0 TO N
260 GOSUB 1000 \ PRINT N$(P)", IT'S YOUR TURN. WHICH OPERATION DO YOU CHOOSE";
270 LINPUT A$ \ IF A$="STOP" THEN 1900
280 IF LEN(A$)<>1 THEN PRINT "ONLY ONE OPERATION AS +,- OR *, PLEASE." \ GO TO 260
290 K=POS(O$,A$,1) \ IF K=0 THEN PRINT "THAT'S NOT A VALID OPERATION." \ GO TO 260
300 IF C%(P,3)<>K THEN IF C%(P,4)<>K THEN PRINT "YOU DON'T HAVE THAT CARD, MY FRIEND!" \ GO TO 260
310 T$="WHICH NUMBER DO YOU USE" \ GOSUB 1500 \ K%=L%
320 FOR I=0 TO 2 \ IF K%=C%(P,I) THEN 340
330 NEXT I \ PRINT "YOU DON'T HAVE THAT NUMBER!" \ GO TO 310
339 REM
340 B%=B%(P%(P)) \ REM PERFORM CALCULATION AND ASK STUDENT
341 REM
350 IF K=1 THEN H=B%+K% \ T$=STR$(B%)+" + "+STR$(K%)+" = "
360 IF K=2 THEN H=B%-K% \ T$=STR$(B%)+" - "+STR$(K%)+" = "
370 IF K=3 THEN H=B%*K% \ T$=STR$(B%)+" * "+STR$(K%)+" = "
380 GOSUB 1500 \ IF L%<>H THEN PRINT "SORRY BUT YOU MUST TRY AGAIN." \ GO TO 380
390 GOSUB 1700
399 REM
400 REM ===> MOVE
401 REM
410 IF H>0 THEN 450
420 IF H<0 THEN 480
430 REM H=0 => NO MOVE.
440 PRINT "ALL RIGHT. YOU DON'T MOVE THIS TURN." \ GO TO 495
450 REM H>0 => CHECK FOR END OF GAME.
460 P%(P)=P%(P)+H \ IF P%(P)>40 THEN 2000
470 PRINT "YOU MOVE "H" FORWARD." \ GO TO 495
480 P%(P)=P%(P)+H \ IF P%(P)<1 THEN H=1-P%(P) \ P%(P)=1
490 PRINT "YOU GO "ABS(H)" BACK! THAT'S A PITY." \ GO TO 495
495 IF P%(P)=1 THEN 530
500 FOR J=0 TO N \ IF P%(P)=P%(J) THEN IF P<>J THEN 520
510 NEXT J \ GO TO 530
520 P%(J)=1 \ PRINT N$(J)" GOES BACK TO 1."
529 REM
530 REM ===> GET NEW CARDS
531 REM
540 C%(P,I)=-5+10*RND \ PRINT "YOU DRAW A "C%(P,I)" AND A ";
550 IF C%(P,3)=K THEN K=3 \ GO TO 570
560 IF C%(P,4)=K THEN K=4 \ GO TO 570
570 C%(P,K)=1+3*RND \ PRINT SEG$(O$,C%(P,K),C%(P,K))
580 NEXT P
590 GO TO 250
999 REM
1000 REM ---< PRINT >---
1001 REM
1010 PRINT TAB(6); \ FOR I=1 TO 10 \ K=I \ GOSUB 1200 \ NEXT I \ PRINT
1020 PRINT TAB(6); \ FOR I=1 TO 10 \ K=I \ GOSUB 1300 \ NEXT I \ PRINT
1030 FOR I=11 TO 20 \ K=51-I \ GOSUB 1200 \ GOSUB 1300
1040 PRINT "                                      ";
1050 K=I \ GOSUB 1300 \ GOSUB 1200 \ PRINT  \ NEXT I
1060 PRINT TAB(6); \ FOR I=30 TO 21 STEP -1 \ K=I \ GOSUB 1300 \ NEXT I \ PRINT
1070 PRINT TAB(6); \ FOR I=30 TO 21 STEP -1 \ K=I \ GOSUB 1200 \ NEXT I \ PRINT  \ PRINT
1080 FOR I=0 TO N \ PRINT N$(I);", YOU'RE AT "P%(I)". YOUR CARDS: ";
1090 FOR J=0 TO 2 \ PRINT SEG$("- +",SGN(C%(I,J))+2,SGN(C%(I,J))+2);
1100 PRINT USING "#",ABS(C%(I,J)); \ PRINT ","; \ NEXT J
1110 PRINT "  ";SEG$(O$,C%(I,3),C%(I,3));","SEG$(O$,C%(I,4),C%(I,4))
1120 NEXT I
1130 RETURN
1200 FOR J=0 TO N \ IF P%(J)=K THEN PRINT " *"; \ GO TO 1220
```

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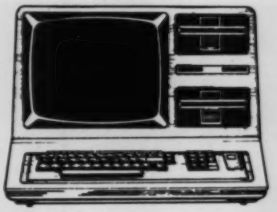

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Reading Is Fundamental
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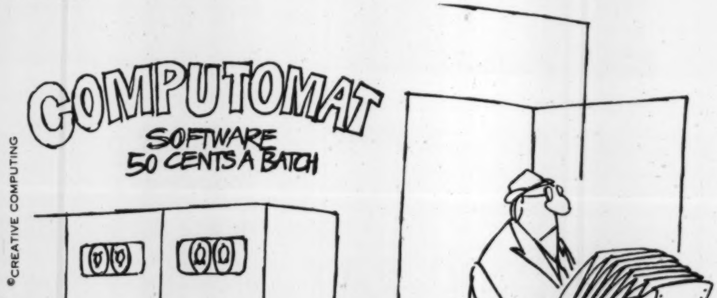
Washington, D.C. 20024

This is a public service message on behalf of Reading Is Fundamental and this magazine.

Algebra, continued...

```
1210 NEXT J \ PRINT "  ";
1220 PRINT USING "##",K; \ RETURN
1300 PRINT USING "####",B%(K); \ RETURN
1499 REM
1500 REM ---< GET NUMBER >---
1501 REM
1510 PRINT T$; \ LINPUT I$
1520 L%=POS(I$," ",1) \ IF L%=0 THEN 1540
1530 I$=SEG$(I$,1,L%-1)+SEG$(I$,L%+1,LEN(I$)) \ GO TO 1520
1540 IF LEN(I$)=0 THEN 1510
1550 IF I$="STOP" THEN 1900
1560 IF LEN(I$)>3 THEN 1510
1570 IF POS("+-",SEG$(I$,1,1),1)=0 THEN I$="+"+I$
1580 IF POS(C$,SEG$(I$,2,2),1)=0 THEN 1610
1590 IF LEN(I$)<=2 THEN 1640
1600 IF POS(C$,SEG$(I$,3,3),1)>0 THEN 1640
1610 PRINT "PLEASE USE ONLY + OR - AS SIGNS, NOT ' '."
1620 PRINT "AND DON'T USE NUMBERS BIGGER THAN 16!"\ GO TO 1510
1640 L%=VAL(I$) \ RETURN
1699 REM
1700 REM ---< GOOD! >---
1701 REM
1710 I$="EXCELLENT GOOD!     TERRIFIC! WOW!!!    GEE!!     OK!!!
1720 H%=RND*LEN(I$)/10
1730 PRINT SEG$(I$,H%*10+1,10*(H%+1))
1740 RETURN
1799 REM
1800 REM ---< INSTRUCTIONS >---
1801 REM
1805 PRINT
1810 PRINT "   YOU PLAY ALGEBRA ALONG THE BORDERS  OF A SQUARE"
1815 PRINT "10 * 10 BOARD.  THE FIELDS HAVE  NUMBERS  FROM ONE"
1820 PRINT "UNTIL 40.  THE POSITIONS OF THE PLAYERS ARE MARKED"
1825 PRINT "BY AN ASTERIX (*) BEFORE THE FIELD NUMBER."
1830 PRINT "   EACH FIELD HAS A VALUE BETWEEN -4 AND +4. EVERY"
1835 PRINT "PLAYER HAS FIVE CARDS:  THREE WITH A NUMBER (AGAIN"
1840 PRINT "BETWEEN -4 AND 4.)  AND TWO WITH AN OPERATION (+,-"
1845 PRINT "OR *.)"
1850 PRINT "   TO MOVE,  YOU GIVE ONE OF YOUR NUMBER CARDS AND"
1855 PRINT "ONE OF YOUR  OPERATION CARDS.  THESE CARDS WILL BE"
1860 PRINT "COMBINED WITH THE FIELD ON WHICH YOU ARE."
1865 PRINT "EXAMPLE:  YOU ARE ON FIELD 5 WHICH HAPPENS TO HAVE"
1870 PRINT "A VALUE OF 2. YOU PRESENT A NUMBER CARD WITH VALUE"
1875 PRINT "-4 AND AN OPERATION CARD '-'."
1880 PRINT "THEN YOU MOVE 2 - (-4) = 6 PLACES TO FIELD 11."
1885 PRINT "THE FIRST PLAYER WHO PASSES 40 WINS!"
1890 GO TO 170
1900 PRINT "WE STOP WITH THE GAME"
1910 GO TO 2020
2000 PRINT
2010 PRINT N$(P);" CONGRATULATIONS! YOU HAVE WON THIS GAME!"
2020 END
```



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CIRCLE 228 ON READER SERVICE CARD

WOMBATS

Wombat.

wom·bats (wŏm'băt's) *n.* Either of two Australian marsupials, *Phascolomis ursinus* or *Lasiorhinus latifrons*, somewhat resembling small bears. [Native Australian name.]

A program to generate word-problems

Michael Potts

WOMBATS is a word-problem generating program for TRS-80 (Model 1 Level 2 16K or above). It appeals to a desire common to children aged 7 to 16 to create nonsense and test limits—"if I type in absurd nonsense, what will the computer do?" My object was to get the child-user to read, analyze and solve problems in order to find out what outrage the machine will next perpetrate. As a motivator, I've found nothing in three years of teaching with a computer that works better than suspense.

I also wanted my children to work on some "literate" programming, made up of sentences in which subjects and objects agree in number, and the words are spelled right . . . that kind of thing (lamentably overlooked in lots of Computer-Aided Instruction programming. But that's another story. . .)

Word problems are important educationally because they synthesize two very different and demanding disciplines—reading and math—and also bridge the gap between abstract math facts (like 2+5=?) and real applications. (Like this box has 32 raisins and there are 4 of us, so how many do we each get?) These are surprisingly tough tasks for many children. The doctrinaire work-book approach bores children—at least it did me when I was a child. Why not use the computer?

The challenge for me was to build in a reasonable amount of variation and surprise, enough repetition to help the shaky reader along, and some record-keeping bells and whistles to help the parent or teacher incorporate WOMBATS into the child's curriculum. Without the superior string-handling functions of the TRS-80, this program would be a mere shadow: Kudos to Radio Shack!

Let's walk right through the program and see what's there. (Numbers in parentheses are line numbers.)

Scaling

The first part of the program (after the lower-case driver and housekeeping) tailors the problems for each child.

Word problems are important educationally because they synthesize two very different and demanding disciplines—reading and math.

The teacher/operator should set this program up with the abilities of the specific child in mind. For the first time or two, a conservative estimate will encourage repeat business—and learning . . . but please, not too simple: the "Help" part is one of the nicest parts of the program.

MAX (100) limits the hardest operation. A child who can't multiply or divide can use the program with MAX set at 1 or 2. The words in the Add and Subtract sections are simpler than in the later problems. The DEFAULT option sets the initial variables at 4 (all operations), largest number 16.

LARGEST NUMBER (110) limits the numbers used. 5 or 6 is very easy, while 40 will generate some that challenge the best mental number-cruncher. (For specifics on number generation, look at lines 500-590.)

5 OBJECTS (120) gives the operator a chance to salt the program with five words of interest to the child—possibly oases in the desert of harder words, perhaps words of specifically funny resonance for the reader. Always remember: this program is for children—keep the words in range.

Invitation (180)

I try to have programs document themselves for the child—tell her the rules before she breaks them. Seems only fair. .

The child should be attended on the first reading, because the helper will be able to tell how the child's reading ability fits the reading level of the problems. A child who can't read the invitation will have difficulty with the easiest problems . .and probably isn't ready for word problems yet.

The child should be encouraged to experiment, push the machine (while, of course, respecting its mechanical qualities); the program doesn't ask for a name, but for a few characters of address (190): Bat Man is perfectly acceptable. Similarly, encourage imagination on other names and objects.

Nonsense Screen

The program scans each child-entry for appropriate capitalization (2300ff, except in UWOMBATS), balance of vowels/consonants, and for length < 16 characters (2200ff).

I've enjoyed watching my children try to figure out just what the machine thinks nonsense is, anyway. They're mystified.

The Problems

A few examples will give you the idea:

"This morning, George looked in his pocket and found 7 battleships. Later he won 5 more in a bet with Bat Man. (That's you.) How many battleships does he have now?"

"Mathilda gave you 4 wood stoves because she had too many. Later she lost

---

Michael Potts, P.O. Box 88, Caspar, CA 95420.

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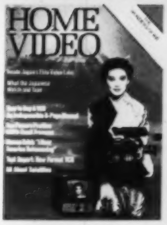
I want more than a peek!



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Kenneth King (far left) and dancers perform "Currency," choreographed by King. Company cameraman Tim Purtell (right) records the action.

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Wombats, continued...

all of them, and you generously gave 0 back. How many stoves do you have now?"

"A flying saucer deposits 4 metal spheres in your kitchen sink. When Jimmy the wimp opens them, 3 wombats pop out of each one. How many wombats do you have now?"

"Goosey's rich uncle gives you a rosewood box with 18 fig trees in it. You share them with 5 friends who come to a tea party. How many fig trees do each of you get?"

The wood stove problem involves zero in the operation: the numbers are random including zero (except in places where that would cause the computer to bomb.) Zero is a nasty concept in word problems, and needs practice. As for fig trees, the reader must remember to include herself in the count-another common real-life pitfall.

Paying Syntax

The problems are made up of three parts—I call them S1, S2 and QU . . . Sentences 1 and 2 and QUestion. They involve a random object OB, the child/user (whose handle is A$) and a "friend" (P1) who, for 'tax purposes has the attributes of pronoun SX ("he" or "she") and a possessive PS ("his" or "her"). A question is built from stock phrases (of which there are 20 sets), the random objects, names, and appropriate plurals, pronouns and possessives. The flying saucer, for example, is constructed at lines 3430—3437. Take a look.

> ***Any program that doesn't help the user get the right answer (if there is one) is only a test. Children don't like tests, and neither do I.***

Objects are stored as two types, ten fixed (3110ff) and ten rotating as RO(1-5) (refreshed at 600ff). This hits the right balance between familiar and surprising. The friend's name gets changed, and a new object gets entered, about once in three problems. This "refresh" ratio can be altered at lines 200 and 3100.

Personalizing the program will make it more interesting for you and the children—feel free to change and add . . . but try to be literate and within range for the children simultaneously. (It's a bit like patting your head and rubbing your belly . . .)

Print or Quit

I used a little INKEY$ loop to give the user a chance to control the program at the end of each correct problem (1720ff).

When "P or Q" appears in the lower left corner after successful completion of a problem, pressing "P" will print the current problem and result on the line printer, while pressing "Q" will end the session. Explain this to the child early in the program, after she knows what's happening.

Help (1000-1450)

Any program that doesn't help the user get the right answer (if there is one) is only a test. Children don't like tests, and neither do I. I think every problem begun should be carried to a satisfactory conclusion. Therefore, each problem carries a hint (in V) which, with strategic repetition of S1, S2 and QU, leads the child through the problem.

This segment appears on a wrong answer. The child can reject the proffered help without loss of points by responding "N." If requested, help, encouragement and hints are given in order to talk the child through the specific problem. Try it out.

Inventory and Score (1790 ff)

This review of objects, problems and percentage score comes up every ten problems. The codes that sometimes appear after "Help" entries are generated during the help segment, as follows:

Digit in place	Problem with
units	getting 1st number
tens	getting 2nd number
hundreds	wrong operation (1=+ 2=- 3=* 4=/)
thousands	math facts (as above)

Zero means no problem in this column; more than 1 in 1s or 10s place means repeated difficulty, while numbers in 100s and 1000s places indicate guessed operation and missed problem, respectively. (Examine lines 1040, 1090, 1200, 1340ff.)

This "difficulty code" puts the child's performance in perspective, and provides the "teacher" with some guidance on what needs special attention on the next group of problems. I'm pleased if this feature doesn't get used: we have lots of extra memory, so let's use it for those rare occasions when it can help the child.

Details

A tape with two versions of WOMBATS is available: I'd be very interested in trading for CAI programs of equal quality. (I would also reluctantly provide the tape for a $10 fee, but given the rarity of good software I'd rather barter.) UWOMBATS is the upper-case-only version of WOMBATS. You'll have to fix this eventually; why not now?

Systems without printers: best disable print options in lines 1720-1735, 1790, and 2500-2520, and delete 700-720. □

```
1 ' WOMBATS - a word problem generating program
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    PO Box 88  CASPAR   CA  95420  (707) 964 0375
2 'WRITTEN 18 APRIL 1980
10 FORI=-16414TO-16385
20 READ BYTE
30 POKE I,BYTE
40 NEXT
50 POKE 16414,226
60 POKE 16415,191
70 POKE 16445,16
80 DATA 221,110,3,221,102,4,218,154,4,221,126,5,183,40,1,119,121,254,32,218,6,5,2
54,128,210,166,4,195,125,4
90 CLEAR 5000
95 DEFINT B-F,J-N,W-X:DEFSTR O-V
99 CLS:PRINT"WOMBATS":PRINT"a word-problem generating game":PRINT"Copyright (c) 1
980 by Michael Potts":PRINT:PRINT
100 PRINT"Problems will randomly choose operations up to the maximum.":INPUT"0=DE
FAULT 1=Add 2=Subtract 3=Multiply 4=Divide  Your MAX";NL
103 IFNL=0THEN150
105 IFNL>4THENNL=4
110 PRINT:INPUT"Largest number in any problem";NMX
120 PRINT:PRINT"I need 5 random objects:":FORN=1TO5:PRINTN;":";:GOSUB2000:RO(N)=T
:NEXT:GOTO170
150 NL=4:RO(1)="snail":RO(2)="bookend":RO(3)="wood stove":RO(4)="rocking chair":R
O(5)="tractor":NMX=16
170 P1="Sienna":PS="her":SX="she"
180 AR=0:WA=0:NR=0:CLS:PRINT"   This program makes up word problems ...with your
help. The":PRINT"screen will ask for names of people and things for the":PRINT"pr
oblems it's inventing."
182 PRINT:PRINT"   The computer will reject any answers with more than":PRINT"16
characters, OR that it thinks are nonsense.":PRINT:PRINT"   Have a good time. Pre
ss ENTER when you're ready to go."
184 I$=INKEY$:IFI$=""THEN184
186 IF ASC(I$)<>13THEN184
189 CLS
190 PRINT"What do I call you   ";:GOSUB2000:IFNF=0THEN193
191 GOTO182
193 A$=T:GOSUB2300:IFCF=1THEN200
195 PRINT:PRINT"Whatever you want me to call you, you're a person, and the":PRINT
"names of persons begin with a CAPITAL letter. Remember the":PRINT"SHIFT key, and
 please tell me again:":GOTO190I:PRINT
200 FP=0:GOSUB400:N=RND(3):ONNGOTO210,220,220:'FLOW CONTROL - GET OPERATION TYPE
210 GOSUB3010:IFNF=0THEN220:'GET NAME(S)
212 ONNFGOTO214,216
```

The story behind the two best selling computer games books in the world.

Computer Games

by David H. Ahl

Everybody likes games. Children like tic tac toe. Gamblers like blackjack. Trekkies like Star Trek. Almost everyone has a favorite game or two.

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Ten years ago when I was at Digital Equipment Corp. (DEC), we wanted a painless way to show reluctant educators that computers weren't scary or difficult to use. Games and simulations seemed like a good method.

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When I left DEC in 1974 I asked for the rights to print the book independently. They agreed as long as the name was changed.

Converted to Microsoft Basic

The games in the original book were in many different dialects of Basic. So Steve North and I converted all the games to standard Microsoft Basic, expanded the descriptions and published the book under the new name Basic Computer Games.

Over the next three years, people sent in improved versions of many of the games along with scores of new ones. So in 1979, we totally revised and corrected Basic Computer Games and published a completely new companion volume of 84 additional games called More Basic Computer Games. This edition is available in both Microsoft Basic and TRS-80 Basic for owners of the TRS-80 computer.

Today Basic Computer Games is in its fifth printing and More Basic Computer Games is in its second. Combined sales are over one half million copies making them the best selling pair of books in recreational computing by a wide margin. There are many imitators, but all offer a fraction of the number of games and cost far more.

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Obstacle
Octrix
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Pasart 2
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Roadrace
Rotate
Safe
Scales
Schmoo
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Seawar
Shoot
Smash
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CIRCLE 350 ON READER SERVICE CARD

```
214 PRINT"I detect nonsense! Please try again.":STOP
220 GOSUB510:'GET NUMBERS
230 GOSUB3100:'GET OBJECT NAME, PRINT FIRST PARA
260 IFNQ<>CATHEN1000
280 PRINT"That's RIGHT, ";A$;".":GOSUB1700:'RECORD KEEPING
290 GOTO200
400 'SETS OPERATION TYPE
410 NO=RND(NL):'1=+ 2=- 3=* 4=/
490 RETURN
500 ONNOGOTO510,510,520,520:'NUMBER CRUNCHING
510 N1=RND(NMX):ONNOGOTO550,560,500,500
520 N1=INT(RND(NMX)/2):N2=INT(RND(NMX)/3):1FN2=0THENN2=1
525 ONNOGOTO500,500,590,530
530 N1=N1*N2:GOTO590
550 N2=RND(NMX):GOTO590
560 N2=RND(N1):IFN2>=1THEN590
570 N2=INT(N2+.5):GOTO590
590 RETURN
600 PRINT"I need the name of an object.";:GOSUB2000
610 IFNF=0THEN640
620 ONNFGOTO630,600
630 PRINT:PRINT"I never heard of ";CHR$(34);T;CHR$(34);" - Sorry.":PRINT"Try some
thing else, please...":GOTO600
640 XN=RND(3):ONXNGOTO645,650,645
645 OB=T
650 N=RND(5):RO(N)=T:RETURN
700 LPRINT STRING$(50,"-");"(";AR+WA:LPRINT:LPRINT"   ";S1:LPRINT"   ";S2:LPRINT:
LPRINT"   ";QU;"?":LPRINT:LPRINT" (";A$" said the answer is";NQ;OB;:IFNQ=1THEN720

710 LPRINT"s";
720 LPRINT".)":LPRINT:RETURN
1000 WA=WA+1:PRINT"-<wrong answer>-  Do you want help?  ";
1010 I$=INKEY$:IFI$=""THEN1010
1020 PRINTI$;:IFI$<>"N"THEN1025
1023 WA=WA-1:PRINT:PRINTSTRING$(50,"x"):GOSUB3350:GOTO260

1025 PRINT"  ...Okay:"
1030 PRINT"   What number do you start with";:INPUTNQ:IFNQ=N1THEN1080
1040 FP=FP+1:PRINT"No. Read the first part again carefully:":PRINT"   ";S1:GOTO10
30
1080 PRINT"   What is the second number";:INPUTNQ:IFNQ=N2THEN1130
1090 FP=FP+10:PRINT"No. Read the second part again carefully:":PRINT"   ";S2:GOTO
1080
1130 PRINT"   What do you do with the numbers, add";:IFNL=1THEN1150
1135 PRINT", subtract";:IFNL=2THEN1150
1140 PRINT",":PRINT"                                    multiply";:IFNL=3THEN1150
1145 PRINT", or divide";
1150 PRINT"?"
1160 I$=INKEY$:IFI$=""THEN1160
1170 PRINTI$;:IFI$="A"THEN1180
1171 IF(NO=1)*(I$="Y")THEN1179
1172 IFI$="S"THEN1182
1174 IFI$="M"THEN1184
1176 IFI$="D"THEN1186
1178 PRINTCHR$(8);:GOTO1160
1179 I$="A"
1180 PRINT"dd":NQ=1:GOTO1190
1182 PRINT"ubtract":NQ=2:GOTO1190
1184 PRINT"ultiply":NQ=3:GOTO1190
1186 PRINT"ivide":NQ=4
1190 IFNQ=NOTHEN1250
1200 FP=FP+(NQ*100):PRINT"No. To do this problem, you need to";:ONNOGOTO1210,1212
,1214,1216
1210 PRINT" add.":PRINT"The clue: ";V;" more.":PRINT"Don't you add";:GOTO1220
1212 PRINT" subtract.":PRINT"The key words: ";V:PRINT"So you subtract, right";:GO
TO1220
1214 PRINT" multiply.":PRINT"The words ";CHR$(34);V;CHR$(34);" are the key.":PRIN
T"If you see equal groups, and you need to know how many they":PRINT"total, isn't
 it easier to multiply";:GOTO1220
1216 PRINT" divide.":PRINT"You need to know how many ";V;",":PRINT"so you divide"
;N1;" into";N2;" groups ...Right";
1220 INPUTQ:IFLEFT$(Q,1)="Y"THEN1250
1230 PRINT"Well, ";A$;", I think the answer is YES."
1250 PRINT"   So do this problem:";"  ";N1;" ";:ONNOGOTO1260,1262,1264,1266
1260 CA=N1+N2:PRINT"+ ";:GOTO1270
1262 CA=N1-N2:PRINT"- ";:GOTO1270
1264 CA=N1*N2:PRINT"* ";:GOTO1270
1266 CA=N1/N2:PRINT"/ ";
1270 PRINTN2;" = ?";
1280 MF=0:GOSUB2400
1290 PRINTCHR$(8);I$;:T=I$:GOSUB2400
1300 IFMF=1THEN1320
1310 T=T+I$:PRINTI$;:GOSUB2400:GOTO1300
1320 NQ=VAL(T):IFNQ=CATHEN1350
1330 PRINT:PRINT"  You need to work on your ";:ONNOGOTO1340,1342,1344,1346
1340 PRINT"addition ";:FP=FP+1000:GOTO1400
1342 PRINT"subtraction ";:FP=FP+2000:GOTO1400
1344 PRINT"multiplication ";:FP=FP+3000:GOTO1400
1346 PRINT"division ";:FP=FP+4000:GOTO1400
1350 PRINT:PRINT"Yes.":GOTO1450
1400 PRINT"facts. "
```

```
1450 NH=NH+1:GOTO1741
1700 AR=AR+1:PRINTAR;" right answer";:IFAR=1THEN1720
1710 PRINT"s";
1720 I%=0:PRINT" so far.";:PRINTTAB(55);"P or Q";
1725 I$=INKEY$:I%=I%+1:IFI%>50THEN1740
1727 IFI$=""THEN1725
1730 IFI$="Q"THEN1970
1733 IFI$<>"P"THEN1725
1735 GOSUB700
1740 PRINTSTRING$(9,CHR$(8)):PRINT
1741 ONNOGOTO1742,1744,1746,1748
1742 OP="+":GOTO1750
1744 OP="-":GOTO1750
1746 OP="*":GOTO1750
1748 OP="/"
1750 NN=LEN(OB):NN=20-NN:R(NR)=OB+"s :"+STRING$(NN," ")+STR$(N1)+" "+OP+STR$(N2)+
" ="+STR$(CA):IFFP=0THEN1770
1760 R(NR)=R(NR)+"       <"+STR$(FP)
1770 IFNR=9THEN1785
1780 NR=NR+1:PRINTSTRING$(50,"="):GOTO200
1785 NT=9
1790 NF=0:PRINT:PRINT"Inventory Coming!  ...do I print it";:INPUTQ:IFLEFT$(Q,1)<>
"Y"THEN1810
1800 NF=1
1810 T=STRING$(50,"%"):GOSUB2500

1820 FORNR=0TONT:T=R(NR):GOSUB2500:NEXT
1830 T="":GOSUB2500
1840 T=A$+" has gotten"+STR$(AR)+" right,"+STR$(WA)+" wrong.":GOSUB2500
1850 IC=INT(100*(AR/(AR+WA))):T="   for a score of"+STR$(IC)+"%   ":IFIC<95THEN18
70
1860 T=T+"VERY "
1870 IFIC<90THEN1890
1880 T=T+"WELL DONE, "+A$
1890 GOSUB2500:T=STRING$(50,"%"):GOSUB2500:INPUT"Press ENTER for more  ";I$:IFI$<
>"Q"THEN1930
1900 PRINT"   It's been a pleasure doing business with you, ";A$:PRINT"Please get
 my next victi ...er, subject.":FORNN=1TO2000:NEXT:GOTO180
1930 FORNR=0TO9:R(NR)="":NEXT:NR=0:GOTO200
1970 PRINT:PRINT"Quitting time, you say. Good.":NT=NR:GOTO1790
2000 'KEYBOARD
2010 T="":PRINT">";
2020 I$=INKEY$:IFI$=""THEN2020
2030 I%=ASC(I$):IF(I%>31)*(I%<65)THEN2080
2040 IFI%>96THEN2070
2050 IFI%<32THEN2100
2060 I%=I%+32:GOTO2080
2070 I%=I%-32
2080 PRINT CHR$(I%);
2090 T=T+CHR$(I%):GOTO2020
2100 IFI%=8THEN2130
2110 IFI%=13THEN2160
2120 GOTO2020
2130 PRINTCHR$(I%);:BS%=LEN(T)-1:IFBS%<1THEN2150
2140 T=LEFT$(T,BS%):GOTO2020
2150 T="":GOTO2020
2160 NF=0:LT=LEN(T):IFLT<17THEN2200
2170 PRINT:PRINT"That's too long for my memory. Please try again.":NF=2:GOTO2290
2200 V(1)="a":V(2)="e":V(3)="i":V(4)="o":V(5)="u"
2210 FORK=1TOLT:FORJ=1TO5:Q=MID$(T,K,1):IFQ=V(J)THEN2240
2220 NEXT:NEXT
2230 GOTO2250
```

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CIRCLE 107 ON READER SERVICE CARD

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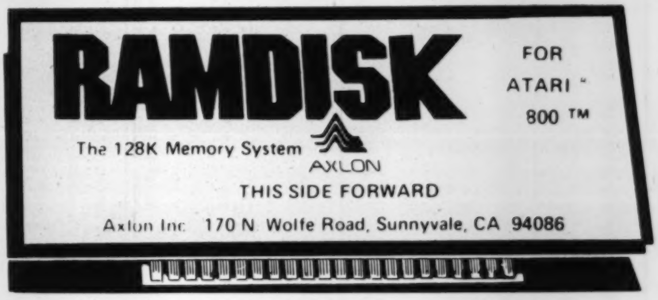

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CIRCLE 114 ON READER SERVICE CARD

```
2240 NF=NF+1:GOTO2220
2250 IFLT<5THEN2270
2260 IFNF<INT(LT/4)THENNF=1:GOTO2290
2270 IFNF>0THEN2285
2280 NF=1:GOTO2290
2285 NF=0
2290 PRINT:RETURN
2300 'CHECKS FOR CAPITAL
2310 T=LEFT$(T,1):IFASC(T)<90THEN2330
2320 CF=0:GOTO2340
2330 CF=1
2340 RETURN
2400 I$=INKEY$:IFI$=""THEN2400
2410 I%=ASC(I$):IF(I%>47)*(I%<58)THEN2440
2415 IFI%=13THEN2430
2420 GOTO2400
2430 MF=1
2440 RETURN
2500 IFNF=0THEN2520
2510 LPRINTT
2520 PRINTT:RETURN
3000 'STORY GENERATION
3010 PRINT"I need the name of a person.  ";:GOSUB2000
3012 IFNF=0THEN3020
3014 ONNFGOTO3016,3010
3016 PRINT"I detect nonsense. I don't think ";CHR$(34);T;CHR$(34);" is really":PR
INT"someone's name. Please try again.":GOTO3010
3020 P1=T:GOSUB2300:IFCF=1THEN3030
3025 PRINT"The names of persons begin with a capital letter.":PRINT"Remember the
shift key. Please try again.":GOTO3010
3030 PRINT"Is ";P1;" a he or a she?  ";:GOSUB2000:SX=T:IFSX="he"THEN3070
3040 IFSX="she"THEN3060
3050 PRINT"I detect nonsense. I don't know any questions about ":PRINTCHR$(34);SX
;CHR$(34);"s, anyway. Please try again.":GOTO3030
3060 PS="her":GOTO3090
3070 PS="his"
3090 RETURN
3100 N=RND(20):ONNGOTO3130,3110,3140,3112,3130,3114,3140,3116,3130,3118,3140,3120
,3130,3122,3140,3124,3130,3126,3130,3128
3110 OB="apple":GOTO3150
3112 OB="peanut":GOTO3150
3114 OB="wing nut":GOTO3150
3116 OB="ballet slipper":GOTO3150
3118 OB="sharp pencil":GOTO3150
3120 OB="red flower"
3122 OB="wombat":GOTO3150
3124 OB="sea urchin":GOTO3150
3126 OB="door knob":GOTO3150
3128 OB="doll shoe":GOTO3150
3130 GOSUB600:IFOB<>""THEN3150
3140 N=RND(5):OB=RO(N)
3150 PRINTSTRING$(50,"-");"(";AR+WA:ONNOGOTO3160,3300,3400,3500
3160 CA=N1+N2:N=RND(5):ONNGOTO3170,3176,3180,3185,3190
3170 QU="does "+P1:V=SX+" takes"+STR$(N1)+", then finds"+STR$(N2):S1=P1+" needs s
omething special at school today,"+CHR$(13)+"so "+SX+" takes along"+STR$(N1)+" "+
OB:IFN1=1THEN3172
3171 S1=S1+"s"
3172 S1=S1+".":S2="On the way to school, "+SX+" sees a hat by the"+CHR$(13)+"road
; under it "+SX+" finds"+STR$(N2)+" more.":GOTO3340
3176 QU="do you":V="you own"+STR$(N1)+", then you're sold"+STR$(N2):S1="You look
in your "+OB+" collection and see that"+CHR$(13)+"you own"+STR$(N1)+" "+OB:IFN1=1
THEN3178
3177 S1=S1+"s"
3178 S1=S1+".":S2="Your friend, "+P1+", sells you"+STR$(N2)+" more.":GOTO3340
3180 QU="does "+SX:V=SX+" made"+STR$(N1)+", then makes"+STR$(N2):S1="Last Monday,
 "+P1+" invented a machine that makes"+CHR$(13)+OB+"s. That Monday, "+SX+" made"+
STR$(N1)+" "+OB:IFN1=1THEN3182
3181 S1=S1+"s"
3182 S1=S1+".":S2="The next day, "+SX+" made"+STR$(N2)+" more.":GOTO3340
3185 QU="does "+P1:V=SX+" bought"+STR$(N1)+", then buys"+STR$(N2):S1="Yesterday,
"+P1+" bought"+STR$(N1)+" "+OB:IFN1=1THEN3187
3186 S1=S1+"s"
3187 S1=S1+".":S2="Today, "+SX+" goes to the store and buys"+STR$(N2)+" more.":GO
TO3340
3190 QU="does "+SX:V=P1+" found"+STR$(N1)+", then won"+STR$(N2):S1="This morning,
 "+P1+" looked in "+PS+" pocket and"+CHR$(13)+"found"+STR$(N1)+" "+OB:IFN1=1THEN3
192
3191 S1=S1+"s"
3192 S1=S1+".":S2="Later, "+SX+" won"+STR$(N2)+" more in a bet with "+A$+". (That
's you.)":GOTO3340
3300 CA=N1-N2:N=RND(5):ONNGOTO3310,3315,3320,3325,3330
3310 S1="Last week, "+P1+" got "+STR$(N1)+" "+OB:IFN1=1THEN3312
3311 S1=S1+"s"
3312 S1=S1+" for "+PS+CHR$(13)+"birthday.":S2="On Saturday, "+SX+" lost "+ STR$(N
2)+" of them.":QU="does "+SX:V=P1+" got"+STR$(N1)+", then"+STR$(N2)+" are lost":G
OTO3340
3315 S1="In your class at school, you made "+STR$(N1)+" "+CHR$(13)+OB:IFN1=1THEN3
317
3316 S1=S1+"s"
3317 S1=S1+", which you brought home.":S2="On your way, you gave "+STR$(N2)+" of
them to "+P1+".":QU="do you":V="you make"+STR$(N1)+", then give away"+STR$(N2):GO
TO3340
```

```
3320 S1=P1+" was carrying "+STR$(N1)+" "+OB:IFN1=1THEN3322
3321 S1=S1+"s"
3322 S1=S1+" in a box.":S2="Coming down the hill, "+SX+" fell, and "+STR$(N2)+" o
f them"+CHR$(13)+"rolled away.":QU="does "+SX:V=SX+" had"+STR$(N1)+", but"+STR$(N
2)+" roll away.":GOTO3340
3325 S1=P1+" found "+STR$(N1)+" "+OB:IFN1=1THEN3327
3326 S1=S1+"s"
3327 S1=S1+" under "+PS+" bed.":S2="Bill, "+PS+" big brother, took "+STR$(N2)+" o
f them away.":QU="does "+P1:V=P1+" found"+STR$(N1)+" but Bill took"+STR$(N2):GOTO
3340
3330 S1=P1+" gave you "+STR$(N1)+" "+OB:IFN1=1THEN3332
3331 S1=S1+"s"
3332 S1=S1+" because "+SX+" had too many.":S2="Later, "+SX+" lost all of them, an
d you generously"+CHR$(13)+" gave "+STR$(N2)+" back.":QU="do you":V=P1+" gave you
"+STR$(N1)+", you gave back"+STR$(N2)
3340 QU="How many "+OB+"s "+QU+" have now"
3345 PRINT"   ";S1:PRINT"   ";S2
3350 PRINT"   ";QU;:INPUTNQ:RETURN
3400 CA=N1*N2:N=RND(5):ONNGOTO3410,3420,3430,3440,3450
3410 S1="You get a surprise! "+P1+" sends you"+STR$(N1)+" box":V=STR$(N1)+" box":
IFN1=1THEN3412
3411 S1=S1+"es":V=V+"es"
3412 S1=S1+" in the mail.":V=V+" ..."+STR$(N2)+" in each box":S2="Each box has"+S
TR$(N2)+" "+OB:IFN2=1THEN3414
3413 S2=S2+"s"
3414 S2=S2+" in it!":QU="do you":GOTO3340
3420 S1=P1+" won"+STR$(N1)+" ticket":V=STR$(N1)+" ticket":IFN1=1THEN3422
3421 S1=S1+"s":V=V+"s"
3422 S1=S1+".":S2="When "+SX+" traded them in, "+SX+" got"+STR$(N2)+" "+OB:IFN2=1
THEN3424
3423 S2=S2+"s"
3424 S2=S2+" for each ticket.":V=V+" ..."+STR$(N2)+" for each ticket":QU="does "+

SX:GOTO3340
3430 S1="A flying saucer deposits"+STR$(N1)+" metal sphere":V=STR$(N1)+" sphere":
IFN1=1THEN3432
3431 S1=S1+"s":V=V+"s"
3432 S1=S1+" in your kitchen"+CHR$(13)+"sink.":S2="When "+P1+" opens them,"+STR$(
N2)+" "+OB:IFN2=1THEN3434
3433 S2=S2+"s pop":GOTO3437
3434 S2=S2+" pops"
3437 S2=S2+" out of every one.":V=V+" ..."+STR$(N2)+" in every one":QU="do you":G
OTO3340
3440 S1="Your friend, "+P1+", dug up"+STR$(N1)+" can":V=STR$(N1)+" can":IFN1=1THE
N3442
3441 S1=S1+"s":V=V+"s"
3442 S1=S1+" full of "+OB+"s.":S2="There ":IFN2=1THEN3444
3443 S2=S2+"were "+STR$(N2)+" "+OB+"s":GOTO3445
3444 S2=S2+"was 1   "+OB
3445 S2=S2+" in each can.":V=V+" ..."+STR$(N2)+" in each can":QU="does "+SX:GOTO3
340
3450 S1=P1+" found"+STR$(N1)+" hole":V=STR$(N1)+" hole":IFN1=1THEN3452
3451 S1=S1+"s":V=V+"s"
3452 S1=S1+" dug in "+PS+" yard.":S2="In each hole there ":IFN2=1THEN3454
3453 S2=S2+"were "+STR$(N2)+" "+OB+"s.":GOTO3455
3454 S2=S2+"was 1 "+OB+"."
3455 V=V+" ..."+STR$(N2)+" in each hole":QU="does "+P1:GOTO3340
3500 QU="does each one":CA=N1/N2:N=RND(5):ONNGOTO3510,3520,3530,3540,3550
3510 N1=N1+CA:CA=N1/(N2+1):S1=P1+" found a bag with"+STR$(N1)+" "+OB:IFN1=1THEN35
14

3512 S1=S1+"s"
3513 S1=S1+" in it.":S2="After school, "+SX+" shared them with "+PS+STR$(N2)+" si
ster":IFN2=1THEN3515
3514 S2=S2+"s"
3515 V="each person gets":S2=S2+".":N2=N2+1:GOTO3340
3516 S2=S2+" nobody, but ate them all. Greedy child!"
3518 QU="does each one":GOTO3340
3520 N1=N1+CA:CA=N1/(N2+1)
3525 S1=P1+"'s rich uncle gives you a rosewood box with"+STR$(N1)+CHR$(13)+OB+"s
in it.":S2="You share them with"+STR$(N2)+" friends who come to a tea"+CHR$(13)+"
party."
3529 V="each friend gets":QU="does each of you":N2=N2+1:GOTO3340
3530 OB="seed":S1="A seed packet has "+STR$(N1)+" seed":IFN1=1THEN3534
3532 S1=S1+"s"
3534 S1=S1+" in it":S2=P1+" plants"+STR$(N2)+" seed":IFN2=1THEN3538
3536 S2=S2+"s"
3538 S2=S2+" in each hole.":V="holes "+P1+" needs":QU="holes does "+P1+" need":GO
TO3560
3540 S1=P1+" worked for"+STR$(N1)+" day":IFN1=1THEN3544
3542 S1=S1+"s"
3544 S1=S1+" building "+OB+"s.":S2="When "+SX+" finished, "+SX+" had made only"+S
TR$(N2)+".":V="days to make each":QU="days does it take "+P1+" to make 1 "+OB:GOT
O3560
3550 S1="You and "+P1+" catch"+STR$(N1)+" "+OB:IFN1=1THEN3554
3552 S1=S1+"s"
3554 S1=S1+" in "+OB+CHR$(13)+"traps in the forest.":S2="You dug"+STR$(N2)+" trap
":IFN2=1THEN3558
3556 S2=S2+"s"
3558 S2=S2+".":V="each trap caught (as an average)":QU="(on the average) did each
 trap catch"
3560 QU="How many "+QU:GOTO3345
```

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Microsystems – the CP/M and S-100 User's Journal

CP/M is the software bus! S-100 is the hardware bus for sophisticated microcomputer users!

If you are a CP/M user, on any system—S-100, Apple, TRS-80, Heath, Ohio Scientific, Onyx, Durango, Intel MDS, Mostek MDX, etc—after all CP/M is the Disk Operating System that has been implemented on more computer systems than any other DOS—then *Microsystems* magazine is the "only" magazine published specifically for you!

Or, if you use an S-100/IEEE-696 based computer—and the most sophisticated microcomputer systems available use the S-100/IEEE-696 hardware bus—then *Microsystems* magazine is the "only" magazine published specifically for you!

We started publishing *Microsystems* almost two years ago to fill the void in the microcomputer field. There were magazines catering exclusively to the TRS-80, Apple, Pet, Heath, etc. system users. There were also broad based publications that cover the entire field but no one system in depth. But no magazine existed for CP/M users—nor did one exist for S-100 users.

The why and what of a software bus

First of all what is a "bus?" And why do we call CP/M "the software bus?"

A "bus" is a technique used to interface many different modules. Examples are the "S-100/IEEE-696 Bus" and the "IEEE-488 Bus." These are hardware buses that permit a user to plug a bus-compatible device into the bus without having to make any other hardware modifications and expect the device to operate with little or no monification.

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CIRCLE 247 ON READER SERVICE CARD

e cart...apple cart...apple c

Chuck Carpenter

In the July '81 column, I mentioned that a mini-assembler would be included in a future column. This is it. Rushika Fernandopulle has provided the program.

Mini-Assembler

If you have an Apple II, you have the mini-assembler. Those of you with a II Plus don't. The program was located in ROM along with several other Integer Basic utilities. The use of Applesoft in the II Plus eliminated these programs. Rushika found a way to extract the program from the language card programs found on the System Master disk. Here's what Rushika had to say: "On the System Master I noticed a program (in machine language—a B, or binary, file) called INTBASIC. It is for use with a language card, and starts at $D000. I needed a mini-assembler, so I decided to use the one on the INTBASIC program by using these steps:

1. Boot DOS with the System Master and then type BLOAD INTBASIC, A$2000.

2. Insert another INITed disk and type BSAVE ASM1,A$4500,L$200.

3. Clear all memory, then type the program shown in Listing 1. (Note: To clear memory, use the monitor move command. First CALL-151 to get to the monitor. Then at the asterisk prompt, type 801:0. Next, type 800 801.95FEM. This sequence will fill all of memory from 800 to 95FF with the 0 character. Address 95FF is the last address just below the beginning of DOS. Now type 3DoG to return to the Basic language in use. Remember to type RETURN at the right places so the computer knows what you want to do—CC)

```
]LIST
10  DATA  559,595,811,864
20  DATA  695,725,735
30  FOR T = 1 TO 4: READ A
40  POKE 21000 + A,84: NEXT
50  FOR T = 1 TO 3: READ A
60  POKE 21000 + A,85: NEXT
]
```

Listing 1. Program used to modify the mini-assembler for relocation at $5400.

4. Type BLOAD ASM,A$5400.

5. Run the program from Listing 1.

6. Type BSAVE MINIASSEMBLER, A$5400,L$200.

7. Run the mini-assembler by using a CALL21862 or in from the monitor use 5566G.

Now I can use the mini-assembler, and this makes machine language programming a lot easier."

Rushika's technique works. I used it to extract a version for use by anyone not having access to the programs mentioned. Listing 2 is my version of the process described above. Here's how it works.

More About Mini

To use the assembler in Listing 2, you first need to type it in to memory. Use the monitor commands to do this. I recommend that you don't enter more than two lines worth of characters at a time. First, get to the monitor as required by your machine. Press RESET or CALL-151—CALL-151 will work with any machine. If you are working with an early version of DOS, also do a 48:0 so you don't mess up the reentry to DOS later.

Once you have *carefully* typed in all the hex data, you can try it out. From the monitor, use 555EG. Now, all the mini-assembler commands shown in the Apple II Reference Manual will work. Follow the procedure shown there to use the assembler. Once you are sure it works, save it on a diskette. Type 3DoG and return to Basic. Now type BSAVE ASM1, A$5400,L$170. If all is well, you will save the program as a binary file.

Of course, you can save it under any name you choose. You may have noticed that the length of my version is shorter than the one described above. When Apple

Listing 2. Apple disassembly of the mini-assembler. Note that you can enter the program at $5492. The jump at $555E is easier to remember.

```
 5400LLLLLLLLL
5400-   E9 81       SBC   #$81
5402-   4A          LSR
5403-   D0 14       BNE   $5419
5405-   A4 3F       LDY   $3F
5407-   A6 3E       LDX   $3E
5409-   D0 01       BNE   $540C
540B-   88          DEY
540C-   CA          DEX
540D-   8A          TXA
540E-   18          CLC
540F-   E5 3A       SBC   $3A
5411-   85 3E       STA   $3E
5413-   10 01       BPL   $5416
5415-   C8          INY
5416-   98          TYA
5417-   E5 3B       SBC   $3B
5419-   D0 6B       BNE   $5486
541B-   A4 2F       LDY   $2F
541D-   B9 3D 00    LDA   $003D,Y
5420-   91 3A       STA   ($3A),Y
5422-   88          DEY
5423-   10 F8       BPL   $541D
5425-   20 1A FC    JSR   $FC1A
5428-   20 1A FC    JSR   $FC1A
542B-   20 D0 F8    JSR   $F8D0
542E-   20 53 F9    JSR   $F953
5431-   84 3B       STY   $3B
5433-   85 3A       STA   $3A
5435-   4C 95 54    JMP   $5495
5438-   20 BE FF    JSR   $FFBE
543B-   A4 34       LDY   $34
543D-   20 A7 FF    JSR   $FFA7
5440-   84 34       STY   $34
5442-   A0 17       LDY   #$17
5444-   88          DEY
5445-   30 4B       BMI   $5492
5447-   D9 CC FF    CMP   $FFCC,Y
544A-   D0 F8       BNE   $5444
544C-   C0 15       CPY   #$15
544E-   D0 E8       BNE   $5438
5450-   A5 31       LDA   $31
5452-   A0 00       LDY   #$00
5454-   C6 34       DEC   $34
5456-   20 00 FE    JSR   $FE00
5459-   4C 95 54    JMP   $5495
545C-   A5 3D       LDA   $3D
545E-   20 8E F8    JSR   $F88E
5461-   AA          TAX
5462-   BD 00 FA    LDA   $FA00,X
5465-   C5 42       CMP   $42
5467-   D0 13       BNE   $547C
5469-   BD C0 F9    LDA   $F9C0,X
546C-   C5 43       CMP   $43
546E-   D0 0C       BNE   $547C
5470-   A5 44       LDA   $44
5472-   A4 2E       LDY   $2E
5474-   C0 9D       CPY   #$9D
5476-   F0 88       BEQ   $5400
5478-   C5 2E       CMP   $2E
547A-   F0 9F       BEQ   $541B
547C-   C6 3D       DEC   $3D
547E-   D0 DC       BNE   $545C
5460-   E6 44       INC   $44
5482-   C6 35       DEC   $35
5484-   F0 D6       BEQ   $545C
5486-   A4 34       LDY   $34
5488-   98          TYA
5489-   AA          TAX
548A-   20 4A F9    JSR   $F94A
548D-   A9 DE       LDA   #$DE
548F-   20 ED FD    JSR   $FDED
5492-   20 3A FF    JSR   $FF3A
5495-   A9 A1       LDA   #$A1
5497-   85 33       STA   $33
5499-   20 67 FD    JSR   $FD67
549C-   20 C7 FF    JSR   $FFC7
549F-   AD 00 02    LDA   $0200
54A2-   C9 A0       CMP   #$A0
54A4-   F0 13       BEQ   $54B9
54A6-   C8          INY
54A7-   C9 A4       CMP   #$A4
54A9-   F0 92       BEQ   $543D
54AB-   88          DEY
54AC-   20 A7 FF    JSR   $FFA7
54AF-   C9 93       CMP   #$93
54B1-   D0 D5       BNE   $5488
54B3-   8A          TXA
54B4-   F0 D2       BEQ   $5488
54B6-   20 78 FE    JSR   $FE78
54B9-   A9 03       LDA   #$03
54BB-   85 3D       STA   $3D
54BD-   20 34 55    JSR   $5534
54C0-   0A          ASL
54C1-   E9 BE       SBC   #$BE
54C3-   C9 C2       CMP   #$C2
54C5-   90 C1       BCC   $5488
54C7-   0A          ASL
54C8-   0A          ASL
54C9-   A2 04       LDX   #$04
```

Listing 2 continued on pg. 226.

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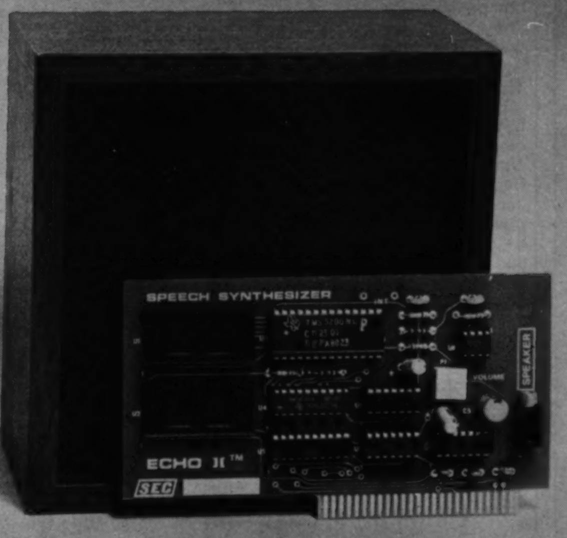

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CIRCLE 268 ON READER SERVICE CARD

wrote the original version, they put a jump address at an easy-to-remember location. Since this address changed anyway, I shortened the wasted space and used a new jump address. The actual entry address is $5492 and you can use this if you choose. I used this version of mini to make this listing, but there is no guarantee it is bugless. All effort was made to check it out. But, you're on your own.

When you write a program be sure to start and end it at safe locations. The programs you write can start at $0800 and end at $53FF. Or they can start at $555F and end at $95FF. Or the program can use any combination of the addresses between these two ranges. Any other addresses used may clobber the assembler, DOS or something else. Be sure you know where your program is located and what it is doing. Of course it's fun to experiment, too. The most that can happen is you will have to reload DOS and the assembler. Be sure you have the program saved and use a scratch disk to do the experimenting. You might do something that causes the system to write on the disk when you don't expect it.

BUGS

The column in the May '81 issue contained a billboard program by Brian J. Winkel. My word processor made a mistake and inserted some typos in Brian's program. (Doesn't everyone blame it on the computer?) Paul Raymer pointed out that JERSY line 50 should be JERSEY. He also pointed out that the *second* asterisk in line 146 should be a colon. The program will run as Brian intended it when you make the changes.

NEXT TIME

I'll talk about getting started with the Apple—its versatility, how to find good Apple software, what hardware and peripherals you should consider—and a whole lot more. ☐

Listing 2 continued

```
54CB-   0A          ASL
54CC-   26 42       ROL   $42
54CE-   26 43       ROL   $43
54D0-   CA          DEX
54D1-   10 F8       BPL   $54CB
54D3-   C6 3D       DEC   $3D
54D5-   F0 F4       BEQ   $54CB
54D7-   10 E4       BPL   $54BD
54D9-   A2 05       LDX   #$05
54DB-   20 34 55    JSR   $5534
54DE-   84 34       STY   $34
54E0-   DD B4 F9    CMP   $F9B4,X
54E3-   D0 13       BNE   $54F8
54E5-   20 34 55    JSR   $5534
54E8-   DD BA F9    CMP   $F9BA,X
54EB-   F0 0D       BEQ   $54FA
54ED-   BD BA F9    LDA   $F9BA,X
54F0-   F0 07       BEQ   $54F9
54F2-   C9 A4       CMP   #$A4
54F4-   F0 03       BEQ   $54F9
54F6-   A4 34       LDY   $34
54F8-   18          CLC
54F9-   88          DEY
54FA-   26 44       ROL   $44
54FC-   E0 03       CPX   #$03
54FE-   D0 0D       BNE   $550D
5500-   20 A7 FF    JSR   $FFA7
5503-   A5 3F       LDA   $3F
5505-   F0 01       BEQ   $5508
5507-   E8          INX
5508-   86 35       STX   $35
550A-   A2 03       LDX   #$03
550C-   88          DEY
550D-   86 3D       STX   $3D
550F-   CA          DEX
5510-   10 C9       BPL   $54DB
5512-   A5 44       LDA   $44
5514-   0A          ASL
5515-   0A          ASL
5516-   05 35       ORA   $35
5518-   C9 20       CMP   #$20
551A-   B0 06       BCS   $5522
551C-   A6 35       LDX   $35
551E-   F0 02       BEQ   $5522
5520-   09 80       ORA   #$80
5522-   85 44       STA   $44
5524-   84 34       STY   $34
5526-   B9 00 02    LDA   $0200,Y
5529-   C9 BB       CMP   #$BB
552B-   F0 04       BEQ   $5531
552D-   C9 8D       CMP   #$8D
552F-   D0 80       BNE   $54B1
5531-   4C 5C 54    JMP   $545C
5534-   B9 00 02    LDA   $0200,Y
5537-   C8          INY
5538-   C9 A0       CMP   #$A0
553A-   F0 F8       BEQ   $5534
553C-   60          RTS
553D-   20 7D F4    JSR   $F47D
5540-   A5 F8       LDA   $F8
5542-   10 13       BPL   $5557
5544-   C9 8E       CMP   #$8E
5546-   D0 F5       BNE   $553D
5548-   24 F9       BIT   $F9
554A-   10 0A       BPL   $5556
554C-   A5 FB       LDA   $FB
554E-   F0 06       BEQ   $5556
5550-   E6 FA       INC   $FA
5552-   D0 02       BNE   $5556
5554-   E6 F9       INC   $F9
5556-   60          RTS
5557-   A9 00       LDA   #$00
5559-   85 F9       STA   $F9
555B-   85 FA       STA   $FA
555D-   60          RTS
555E-   4C 92 54    JMP   $5492
5561-   FF          ???
5562-   FF          ???
5563-   FF          ???
5564-   FF          ???
5565-   FF          ???
*
```

ENTRY
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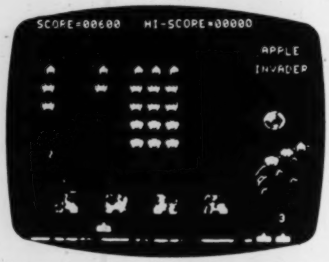

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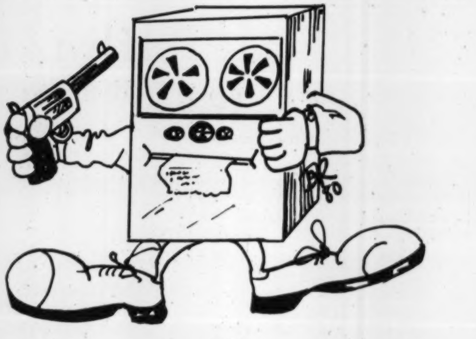
New Functions for Uncertainty Calculations



M.P. Antonovich

Suggestions for enhancing standard computer languages. (This is a nice exercise for beginners: write programs to simulate these functions.) Good luck with the last one.

In these modern times, when everything seems to be less certain, I have found the need to expand the current capabilities of the modern computer programming languages in order to allow them to adjust to reality. I have listened to the needs of many experts to derive ten additional functions to be incorporated into future Basic and Fortran compilers. Without further delay, here they are:

1. A<>B*C=5

The above function will allow the user to specify A to be any number other than the result of B*C+5. Variations on this function include:

```
A<B*C+5
```

which specifies A to be less than B*C+5, and

```
A>B*C+5
```

which specifies A to be greater than B*C+5

It should be noted that any function can be used on the right side of the equation in the majority of cases except A<>A which may lead to incorrect results.

2. IF A=73 SOMETIMES 200

This statement provides the user with the capability of inserting uncertainty into a conditional GOTO statement. A similar statement can be applied to unconditional GOTO statements as follows:

```
SOMETIMES 200
```

As the user becomes more familiar with these statement forms, he can begin to write more complicated examples such as:

```
IF A=73 SOMETIMES 200
OR OTHERTIMES 300
IF NOT THEN 405
OR ELSE MAYBE 475
```

3. NOPRECISION A,B,D

This statement will reduce variables A,B and D to a no-precision status in all calculations. This function is important in uncertainty calculations where numbers are not even known to one significant figure, especially where calculations are of type 1, above.

4. REDUCEPACE

REDUCEPACE is a special function I have found to be in great demand. It has been reported that most computer errors occur in the most difficult parts of the program. Therefore, I have found the need for the REDUCEPACE statement to slow calculation speed so the computer does not make a mistake by rushing over these sections. A RESUMEPACE statement should precede the next easy section to optimize computer time.

This function has three arguments which specify whether the answer must be an integer number, a floating point number, or a simple "YES" or "NO".

5. GRAB (A) FROM ARRAY (C)

This function will pick any element from the array C and assign the value to the variable A for all further calculations.

6. EXTRAPOLATE (C)

In the above function, C is an array defined in a previous DIMENSION statement. The purpose of this statement is to help all of those programmers who have on occasion tried to write, read, or use values beyond the dimension of the array C. This function will extrapolate as far as necessary to accommodate all reasonable requests for array C, or any other array. If the specified array is not known to the program, tasteful default values are supplied.

7. DELPHI (I,X,A)

In the course of most business discussions, you often hear the words, "I won't believe it unless you have the computer back it up." Everyday businessmen are running to the computer for the answers to their business and social problems. This function will help the computer make those decisions by relying on an ancient technique used since the beginning of recorded history. This function has three arguments which specify whether the answer must be an integer number, a floating point number, or a simple "YES" or "NO". Use this function with care because it will carry great weight.

8. SHUFFLE

The SHUFFLE command provides an additional way to add uncertainty into your program by randomizing the order of all lines in the program. I believe that this statement provides the most profound and powerful degree of uncertainty that can be input into a program.

9. GIVEUP 600

This statement tells the computer where to go when it is so totally confused that it no longer knows where it is. In this case it should go to 600.

10. SUICIDE

This statement is an extreme version of the GIVEUP statement and should only be used as a last resort. It tells the computer that if giving up does not help because the problems are too severe, that it should end it all. At this point, all systems will go down, lights will go out, air conditioning will turn off, printers will silence, and all the little floppies will stick up in the air. This statement has the additional benefit of replacing software error by hardware error, which can in principle be fixed more easily. It is especially useful as deadlines approach.

I sincerely hope that these new functions will help the frazzled programmer in dealing with the uncertain world we live in. Remember that nothing in this world is perfect, and indeed, neither are these commands, but they may help you over some tight spots. ☐

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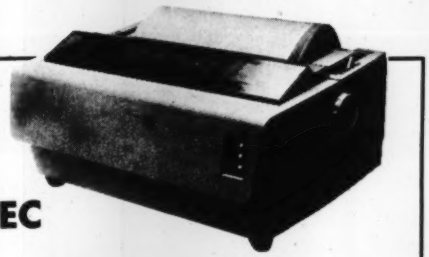

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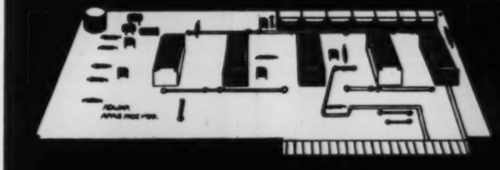

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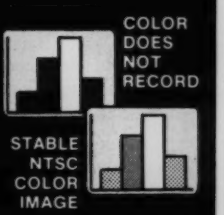

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ATARI 800

A Beginner's Guide to Player-Missile Graphics

David and Sandy Small

Back when I was first working on an Atari 800, I tried to figure out Player-Missile graphics. First, I asked everyone I knew what P-M was and how it worked. "Well, like, man, it's a special subsystem with a reserved memory area that's really hard to use and you use Peek(106) to find an open page, man, then bump it 1024 and do a DMA write then hit D-Mack-Tull and Grack-Tull and it fires up."

And perhaps the best of all, "It's how they did Star Raiders." (Mind you, these were people who programmed Ataris for a living!)

Said I, "There's got to be a better way." I then retired to a hilltop in Tibet with an Atari, and several hundred pages of manuals lent to me by some kind soul in a San Jose computer club, and started trying to figure it out. Long did I puzzle over the hardware manual (and still do). My back issues of *Creative* arrived with snow on them, all wrinkled up. But at last I won out: I returned understanding Player-Missile graphics. And in this column I shall try to impart to you, willing disciple, some of this knowledge, and help you achieve good karma.

In order to understand P-M graphics, it's best to start at the low level hardware functions and work up to the automatic DMA. So let's start at the TV.

A TV picture is made up of horizontal scan lines output from a source in time with the scanning of the TV. In our case, the source is the Atari, busily outputting data to the TV and trying to keep up with it. A special chip, called Antic, was designed to aid the main 6502 processor of the Atari in generating displays. (A longer and more detailed view of how the Atari generates these graphics appeared in the July 1981 issue of *Creative*, but is too long to repeat here.)

There's another chip called CTIA. CTIA is the chip which handles the assignment of color and such; Antic is more concerned with getting data from memory location for CTIA (by DMA) in time to keep up with the TV. Because they are reincarnated slave drivers and prone to such behavior, the Atari designers felt that CTIA just didn't have enough to do, so they thought up another task for it.

CTIA already keeps track of where he is horizontally on each scan like they reasoned. So let's have him keep an eye on a memory location at the same time for a special purpose. In this location is a number that corresponds to a horizontal position on the TV screen. I'll refer to the memory location where horizontal information is stored as a "horizontal position register."

Now, let's say CTIA should find that his horizontal position at the moment happens to equal this horizontal position register. Great things begin to happen! CTIA looks to another register to get one byte of data (this one I'll call a "graphics data register"). He then takes the first bit of data in this register, puts it onscreen as a dot if 1, or skips it if 0. For the next dot over, when he gets there, he does the same thing. He works his way from left to right onscreen, left to right through the eight bits of data—most significant bit first. He puts these eight bits of data onscreen at a color and luminance specified by yet a third special register, the "color/lum register."

To get an overview of this process, let's say we have 150 stored in the horizontal position register, a color of bright green at 10 intensity in the color/lum register, and a bit pattern of 11001011 stored in the graphics data register. When CTIA,

Listing 1.

```
1 REM PROGRAM 1
5 REM xxxx DEFINES
10 HPOS0=53248
20 BITS0=53261
30 COL0=704
40 SIZE0=53256
100 REM xxxx PROGRAM 1
110 REM xxxx GENERATE A FIXED PLAYER
120 REM
130 REM xxxx SET HORIZ POSITION
140 POKE HPOS0,120
150 REM xxxx SET COLOR
160 POKE COL0,202:REM B.GRN,INTEN=10
170 REM xxxx SET DATA
180 POKE BITS0,218:REM 1011 0101
190 REM xxxx SET SIZE
200 POKE SIZE0,0
```

Listing 2.

```
1 REM PROGRAM 2
5 REM xxxx DEFINES
10 HPOS0=53248
20 BITS0=53261
30 COL0=704
40 SIZE0=53256
100 REM xxxx PROGRAM 4
110 REM xxxx SHIFT PLAYER COLORS
120 REM
130 REM xxxx SET HORIZ POSITION
140 POKE HPOS0,150
170 REM xxxx SET DATA
180 POKE BITS0,203:REM 1100 1011
190 REM xxxx SET SIZE
200 POKE SIZE0,0
300 REM xxxx SHIFT PLAYER COLOR
310 FOR PCOL=0 TO 255 STEP 2
320 POKE COL0,PCOL
330 NEXT PCOL
340 GOTO 310
```

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Listing 3.

```
1 REM PROGRAM 3
5 REM **** DEFINES
10 HPOS0=53248
20 BITS0=53261
30 COL0=704
40 SIZE0=53256
100 REM **** PROGRAM 2
110 REM **** ROTATE A PLAYER
120 REM
130 POKE HPOS0,150:REM HORIZ POS
150 REM **** SET COLOR
160 POKE COL0,202:REM B GRN,INTEN=10
190 REM **** SET SIZE
200 POKE SIZE0,0
300 REM **** MODIFY BIT PATTERN
310 FOR T=0 TO 255
320 POKE BITS0,T
325 FOR DELAY=1 TO 100:NEXT DELAY
330 NEXT T
340 GOTO 310
```

Listing 4.

```
1 REM PROGRAM 4
5 REM **** DEFINES
10 HPOS0=53248
20 BITS0=53261
30 COL0=704
40 SIZE0=53256
100 REM **** PROGRAM 2
110 REM **** ROTATE A PLAYER
120 REM
150 REM **** SET COLOR
160 POKE COL0,202:REM B GRN,
    INTEN=10
170 REM **** SET DATA
180 POKE BITS0,203:REM 1100 1011
190 REM **** SET SIZE
200 POKE SIZE0,0
300 REM **** ROTATE RIGHT
310 FOR T=40 TO 200
320 POKE HPOS0,T
330 NEXT T
340 GOTO 310
```

Listing 5.

```
1 REM PROGRAM 5
5 REM **** DEFINES
10 HPOS0=53248
20 BITS0=53261
30 COL0=704
40 SIZE0=53256
100 REM **** PROGRAM 5
110 REM **** MODIFY PLAYER SIZE
120 REM
130 REM **** SET HORIZ POSITION
140 POKE HPOS0,120
150 REM **** SET COLOR
160 POKE COL0,202:REM B GRN,INTEN=10
170 REM **** SET DATA
180 POKE BITS0,203:REM 1100 1011
300 REM **** SHIFT PLAYER SIZE
310 POKE SIZE0,0
315 PRINT "SIZE NORMAL"
320 GOSUB 1000
330 POKE SIZE0,1
335 PRINT "SIZE X 2"
340 GOSUB 1000
350 POKE SIZE0,3
355 PRINT "SIZE X 4"
360 GOSUB 1000
370 GOTO 310
1000 FOR Z=1 TO 1000:NEXT Z:RETURN
```

busily scanning across the screen, finds his current position is 150, he will plot—dot dot (skip) (skip) dot (skip) dot dot—from his current position, working to the right (continuing the sweep). The dots will be green. CTIA will then finish the rest of the scan line with display list stuff. In the next line, he will again get to the 150 midway across the screen, and copy the graphics data register at the same color onto the TV. This process will happen every time he hits 150 horizontally. (Figure 1.)

What we end up with is a vertical green stripe at horizontal position 150, exactly matching the bit pattern above. Let's go ahead and run a program to do just this, so you can see what it looks like. (See Listing 1.)

Now, I'd like to have you briefly play around with this program to learn about the registers. Let's change the color/lum, the graphics data, and the horizontal position registers. The effects will be, respectively, changing the color, the bit pattern, and the horizontal position of the stripes. Run the programs in Listings 2, 3, and 4 to see these effects.

Next, I'll have to introduce you to the "size register." The size register tells CTIA how big to make his dots when he puts them on screen. He can make them normal size, twice as large, or four times as large. (All he does is plot the same data two or four times as he scans across the screen if we tell him to. Thus the stripe will grow from the left, with the left border [at 150] staying constant.) Run the program in Listing 5 to see this particular effect. A zero in this register means times one, a one means times two, and a three means times four.

The object you see in front of you, this stripe, is known as a "player." If you imagine an object that is exactly the same as a player, but is only two bits wide instead of eight, you have a "missile." Hence the name, "player-missile."

Well, you say, is that all? What good is a green stripe in the middle of the TV that doesn't even shut off when I quit running my program?

That's a good point. The thing is, we don't have to leave the data in the graphics register on all the time. Let's say we leave it all 0's for a while from the top of the screen. CTIA will plot nothing, just putting the usual background stuff (display list) on that scan line at 150. But if we should suddenly put some data—for example, 11111111—in the graphics data register, it will plot in the next scan lines from

Figure 1.

The Player

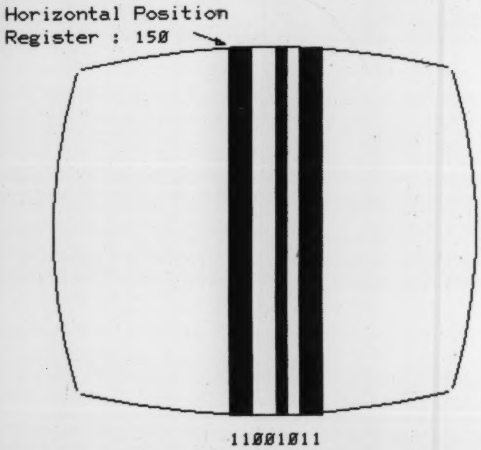
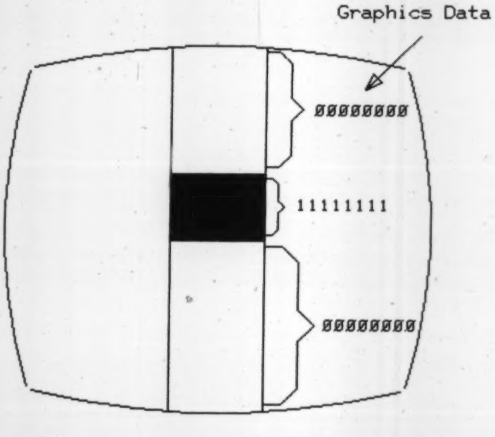


Figure 2.

The Square Player



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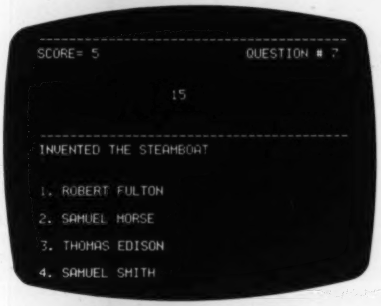

```
SCORE= 5                QUESTION # 7

               15

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2. SAMUEL MORSE
3. THOMAS EDISON
4. SAMUEL SMITH
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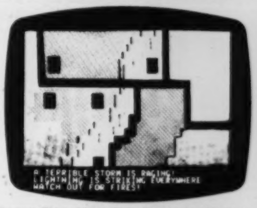
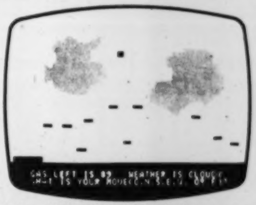


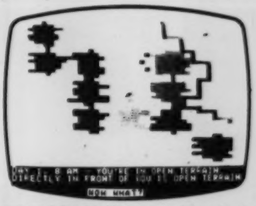
```
A TERRIBLE STORM IS RAGING!
LIGHTNING IS STRIKING EVERYWHERE
WATCH OUT FOR FIRES!
```

Forest Fire. Use chemical retardants and backfires to control raging forest fires.



```
GAS LEFT IS 89   WEATHER IS CLOUDY
WHAT IS YOUR MOVE(C,N,S,E,W, OR F)?
```

Fishing Trip. Try to catch flounder and salmon while avoiding logs, sharks, bad weather and running out of fuel.



```
DAY 1, 8 AM -- YOU'RE IN OPEN TERRAIN
DIRECTLY IN FRONT OF YOU IS OPEN TERRAIN
NOW WHAT?
```

Treasure Island I. Your map shows buried treasure but unfortunately you don't know where you are. Try to find the treasure while moving about and observing your surroundings. You have a 3-day supply of food and water. You may find useful objects (compass, weapons, a horse) but watch out for hazards (robot guards, pirates, caves, crocodiles, mountain lions and more).

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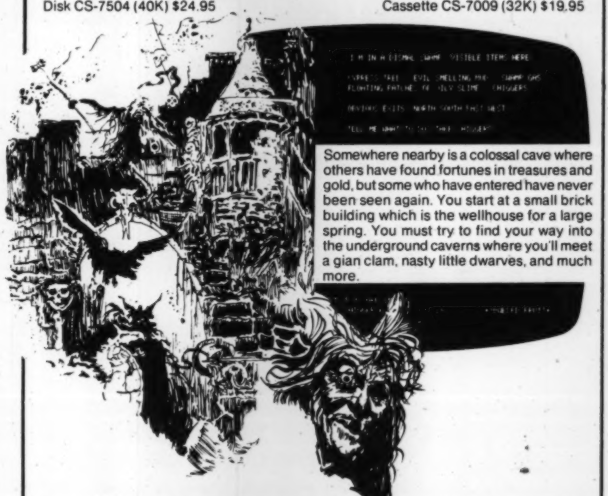

```
I M IN A DISMAL SWAMP  VISIBLE ITEMS HERE

CYPRESS TREE  EVIL SMELLING MUD  SWAMP GAS
FLOATING PATCHES OF OILY SLIME  CHIGGERS

OBVIOUS EXITS  NORTH SOUTH EAST WEST

TELL ME WHAT TO DO? [illegible]
```

Somewhere nearby is a colossal cave where others have found fortunes in treasures and gold, but some who have entered have never been seen again. You start at a small brick building which is the wellhouse for a large spring. You must try to find your way into the underground caverns where you'll meet a gian clam, nasty little dwarves, and much more.

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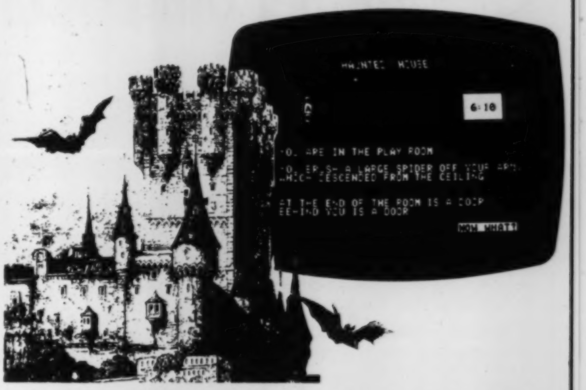

```
HAUNTED HOUSE

                                6:10

YOU ARE IN THE PLAY ROOM

YOU BRUSH A LARGE SPIDER OFF YOUR ARM
WHICH DESCENDED FROM THE CEILING

AT THE END OF THE ROOM IS A DOOR
BEHIND YOU IS A DOOR
                               NOW WHAT?
```

It's 6:00 pm and you have until midnight to find the secret passageway out of a large rambling HAUNTED HOUSE. During your search you'll encounter skeleton keys, charms, friendly ghosts, and evil spirits. Sound effects add to the eerieness. The layout changes in every game.

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then on. Then we can turn it off, by putting 0's back into the register, and we will have a square onscreen. It will really be a stripe, with a lit square in the middle of it, but to us it will appear to be just a square. (Figure 2.)

Now this is starting to get useful. We could change the shape of the square by changing the data we put in the graphics control register. We can move it horizontally by changing the horizontal position register, or vertically by changing where we decide to click the graphics data register on and off. Then we will have an object moving around on the TV screen. Did I say "an" object? I should mention there are four players and four missiles available, each with separate controls. Table 1 lists the control memory locations.

Missiles have the same colors as their players. Missiles can also be grouped together to form a fifth player; four missiles two bits wide equal one player eight bits wide, get it? All missiles have the same size and same data (usually two on bits anyway).

Some of the above demo programs should now become clear. I have set Player 0's horizontal position to 150, his color/lum to bright green at intensity ten (color/lum register = 16 *(color number) + Lum), and his graphics data to CB hex, or 203 decimal. Alas, I haven't written the color/lum information to the location listed above, however. Let me pass on a sad experience to tell you why.

Inside the operating system of the Atari, invisible to you, exists what are known as "shadow registers." These registers contain what the O.S. currently thinks the color/lum and so forth of the players and missile are. Now at the beginning of every screen refresh, the hardware registers for P-M for which the O.S. has a shadow are reloaded from the O.S. data. This means if you go in and change the addresses shown above, with a POKE, in some cases the change will only last until the next refresh: 1/60th of a second. So for the O.S. shadowed hardware locations listed above, POKE into the O.S. shadow register, *not* the hardware register, for a permanent effect.

Another good use for this table is direct Setcolor poking. Now all a Setcolor does is take the color, multiply it by 16, add the lum you specify, and POKE it into the above O.S. shadow locations. For a much faster Setcolor, just do a POKE (playfield O.S. shadow location), (16*color) + Lum. The O.S. locations to look for are the playfield areas, also known as color registers

Listing 6.

```
 10 REM PROGRAM 6. USE ALL PLAYERS.
 20 REM DEMONSTRATES PRIORITY
 30 POKE 623,2:REM P0 HIGHEST
 40 REM POKE A 2 TO HAVE PLAYERS
    2,3
 50 REM HAVE LOWER PRIORITY THAN
    PLAYF
 60 POKE 704,4:REM COLOR P0 GREY-LO
 70 POKE 705,58:REM COLOR P1
    ORANGE-HI
 80 POKE 706,90:REM COLOR P2
    PURPLE-HI
 90 POKE 707,196:REM COLOR P3
    GREEN-LO
100 REM
110 POKE 53261,255:REM BITS P0
120 POKE 53262,255:REM BITS P1
130 POKE 53263,255:REM BITS P2
140 POKE 53264,255:REM BITS P3
150 PRINT "PLAYER 0 = GREY"
160 PRINT "PLAYER 1 = ORANGE"
170 PRINT "PLAYER 2 = PURPLE"
180 PRINT "PLAYER 3 = GREEN "
190 REM CYCLE THROUGH PRIORITIES
200 FOR X=1 TO 15
210 POKE 623,X
220 PRINT "PRIORITY CODE =";X
230 FOR T=36 TO 218 STEP 3
240 POKE 53248,20+T:REM PLAYER 0
250 POKE 53249,T:REM PLAYER 1
260 POKE 53250,218-T:REM PLAYER 2
270 POKE 53251,239-T:REM PLAYER 3
280 FOR Z=1 TO 15:NEXT Z
290 NEXT T
300 NEXT X
310 GOTO 200
```

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```
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←
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←
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Table 1. Player-Missile Controls.

Object Number	Horizontal Position Register	Graphics Data Register	Color/Lum Register	O.S.* Shadow	Size Register
Player 0	D000-(53248)	D00D-(53261)	D012-(53266)	704	D008-(53256)
Player 1	D001-(53249)	D00E-(53262)	D013-(53267)	705	D009-(53257)
Player 2	D002-(53250)	D00F-(53263)	D014-(53268)	706	D00A-(53258)
Player 3	D003-(53251)	D010-(53264)	D015-(53269)	707	D00B-(53259)
Missile 0	D004-(53252)	D011-(53265)	same as P0		D00C-(53260)
Missile 1	D005-(53253)	same	same as P1		same
Missile 2	D006-(53254)	same	same as P2		same
Missile 3	D007-(53255)	same	same as P3		same

O.S. Shadow Registers**

–ANTIC–

O.S. Location	Hardware Register
22F H (559D)	D400 H (DMA CTL)***
2F3 H (755D)	D401 H (CHA CTL)
230 H (560D)	D402 H (Dlist L)
231 H (561D)	D403 H (Dlist H)
2F4 H (756D)	D409 H (CH BASE)

–CTIA–

O.S. Location	Hardware Register	
26F H (623D)	D01B	(PRIOR)
2C0 H (704D)	D012	(Player 0 Color)
2C1 H (705D)	D013	(Player 1 Color)
2C2 H (706D)	D014	(Player 2 Color)
2C3 H (707D)	D015	(Player 3 Color)
2C4 H (708D)	D016	(PlayField 0 Color)
2C5 H (709D)	D017	(PlayField 1 Color)
2C6 H (710D)	D018	(PlayField 2 Color)
2C7 H (711D)	D019	(PlayField 3 Color)
2C8 H (712D)	D01A	(PlayField 4 Backgnd Color)

Refer also to Atari columns listing hardware register addresses.

* O.S. or Operating System—A control progam that allows the computer to react with other programs, and handle input and output.

** Shadow Register—An area in memory that stores information to be transferred to a hardware control device.

*** DMA or Direct Memory Access—Allowing information in memory to be transferred from one location or device to another without using the main microprocessor. The Atari uses the Antic microprocessor to transfer information from memory to the television screen.

Abbreviations CTL = Control DList = Display List H = High Byte L = Low Byte

to the Basic programmer. (2C4-2C8 H)

The information provided so far will be quite helpful. You can get some really neat color effects running players back and forth. Try the program in Listing 6 for this effect and feel free to modify it in all sorts of ways. Note the effect, though, when two players run over one another, or when a player runs over some background (display list) data!

When two players or missiles (or more) "collide," what happens? CTIA will have two "on" bits of data from two objects and has to resolve the priority conflict. First, it lets you know they have collided (remember, that doesn't just mean their horizontal position has matched, it means that while plotting "on" bits of graphics data registers CTIA encountered two in the same place) writing into a "collision register." CTIA then follows a priority scheme to tell it which player to plot over which, and whether to plot players over display list data. You select the scheme you want with a POKE. Table 2 lists the different schemes.

Player-Missile DMA

So far we have a vertical stripe onscreen and some interesting color effects. Basic is nowhere near fast enough to switch the thing off and on to get an "object" on screen. And even if we were to work in assembly language, we would tie up the 6502 processor doing all this on/off stuff and writing the graphics registers, and it wouldn't have time to do much else.

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Table 2. Priority table.

Location D01B (53275) contains the priority data. Use OS 632D as this address is shadowed.

Select either 8, 4, 2, or 1 to POKE with. Adding them gives odd results consisting of black overlapping regions. (Experiment!)

8	4	2	1	
P-F 0	P-F 0	Play 0	Play 0	Highest Priority
P-F 1	P-F 1	Play 1	Play 1	
Play 0	P-F 2	P-F 0	Play 2	
Play 1	P-F 3&5	P-F 1	Play 3	
Play 2	Play 0	P-F 2	P-F 0	
Play 3	Play 1	P-F 3&5	P-F 1	
P-F 2	Play 2	Play 2	P-F 2	
P-F 3&5	Play 3	Play 3	P-F 3&5	
BACKGND	BACKGND	BACKGND	BACKGND	Lowest Priority

Add 10H (16 D) to let all missiles become the color of playfield 3. Thus you can position all the misssiles for a fifth player object. Add 20H (32D) to have a different color (a logical OR) occur during an overlap.

"Play" refers to a Player. "P-F" refers to a playfield, or display list generated, object. (Remember the four available color registers?)

Use this priority chart aftr you have decided who should have priority over whom, to select the scheme that you wish.

Designer 1: Well, the problem is, we don't want to tie up the 6502 with all this player-missile stuff.

Designer 2: "Yeah, kinda reminds me, though of another situation. Remember when we did the display list, and we didn't want to tie up the 6502 with doing the screen refreshes?

Designer 1: Right. We let Antic do all the display work to free up the 6502...Hmmmmm.

(Antic, hearing this, realizes something is about to happen and quietly slinks toward the door, tail between legs and ears drooping, trying to attract as little attention as possible.)

Designer 1 and 2 have the same idea at the same instant: "Let Antic do it! We've already assigned him to do display work; why not let him help us with P-M? Antic! Here boy! Now where did he go?

Needless to say, they caught old Antic and set him to helping with P-M graphics. You don't *have* to use Antic to help you, as we've seen with our demonstration program. Antic is just there to help if you want him to, to take some of the load off the 6502 (and you). There are applications which benefit from both using Antic and not using him, so keep the above "direct" player-missile graphics method in mind. It's what Antic uses anyway.

Let's set up a table in memory. It will be 256 bytes long. Each byte in that table corresponds directly to one horizontal scan line on the TV. (Well, yes, there are 192 scan lines on the TV, so there's a bit of overkill. You'll note a player extends all the way offscreen, past where Antic is generating display list scan lines.)

Now if we tell him to, CTIA will tap Antic on the shoulder each time one of his horizontal position registers matches his current position, and say, "Hey, give me the graphics data byte for this particular line number." Antic will go to memory, fetch the byte, and feed it to CTIA. The neat thing is, once you set up the 256 byte area and tell them to get going, the 6502 is free to do whatever you want it to. The "Player-Missile DMA" becomes completely automatic then. (Figure 3.)

In this method, an object is defined by a few 1 bits in this table which correspond directly to a vertical stripe onscreen. If we turn on a few bits, they show up in the corresponding screen position. If we copy them upwards in the byte table, the object they show will move up. We control their horizontal position via the horizontal position register, color through the O.S. shadow register, size, and so on.

This technique is what most articles on P-M graphics use. As we've seen, it is a higher-level technique than the more direct method of writing to the hardware registers; it just involves letting Antic do our work for us. Be sure to keep the earlier technique in mind, though.

There are many things you have to do to initialize P-M DMA and get things rolling. You have to reserve a location in memory for player-missile DMA. Finally, you must set colors and such (as shown here) to get the players to show up.

It is difficult to learn to apply P-M graphics using the DMA table, with all the pesky details, any other way than by example. There are just too many registers and options in a list to be anything but a reference aid. So what I'll do is take a P-M example from an earlier issue and go through it, in detail, with you, pointing out the miscellany on the way. There really isn't much new, now that we've

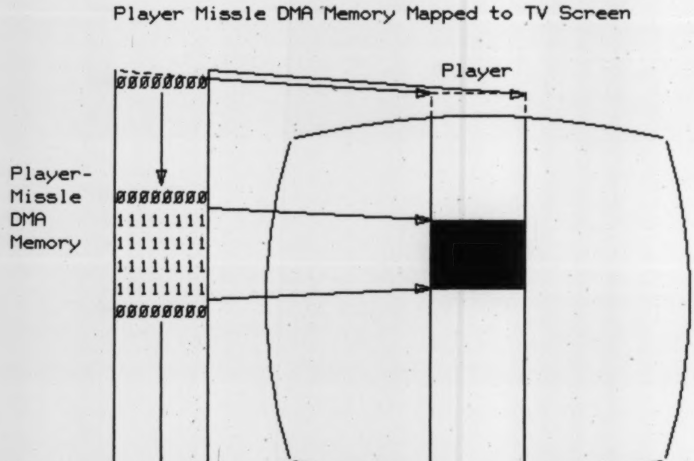
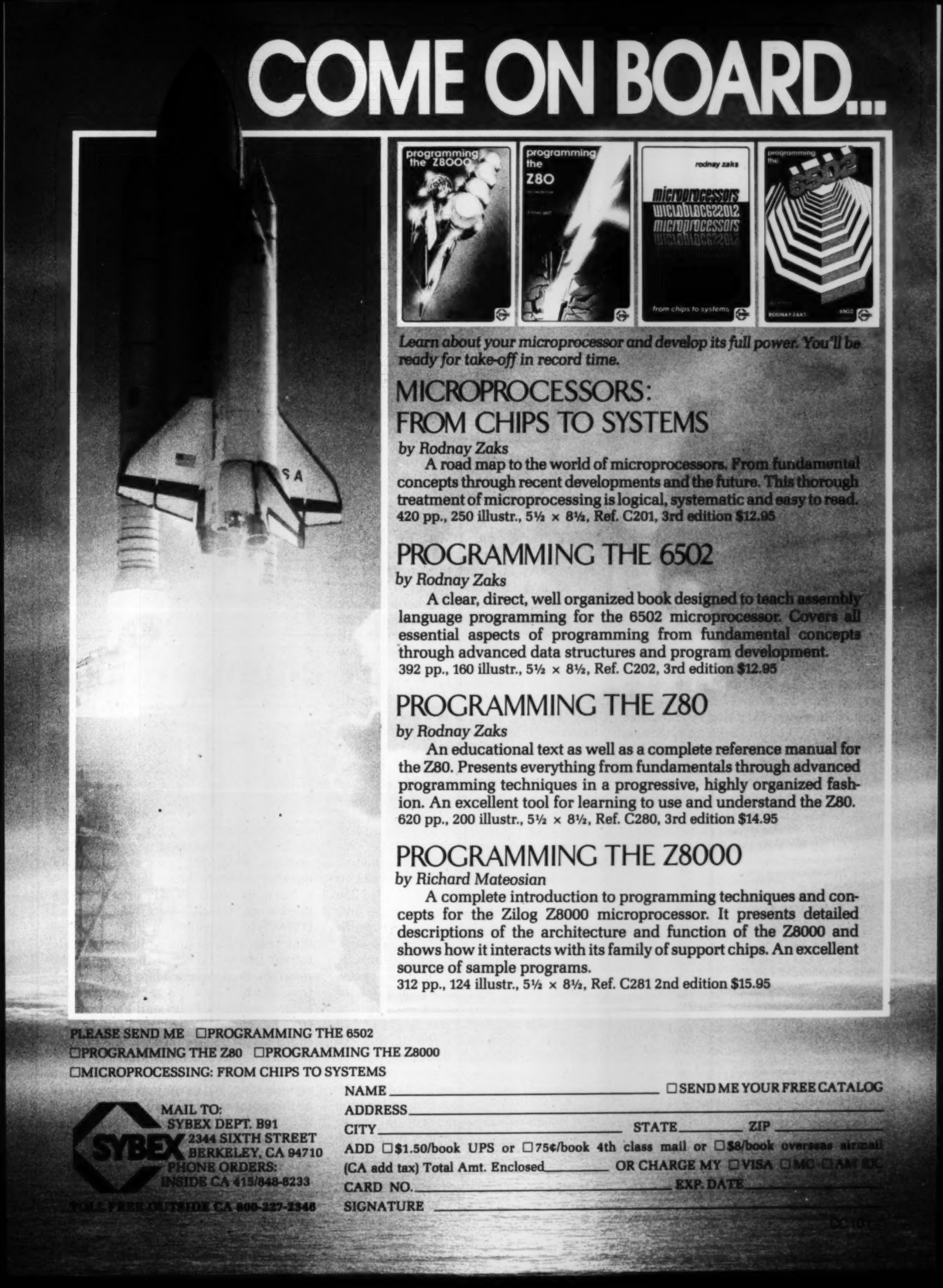


Figure 3.



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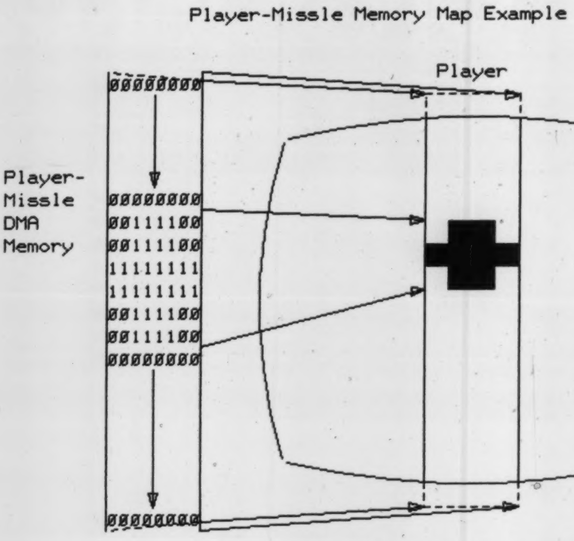

Figure 4.

covered the hardware addresses and concepts.

In January George Blank gave a fine example of DMA P-M graphics. (See Listing 7.) Let's go through the program briefly to see how it works in relation to our example.

Line 30 POKEs into an O.S. location which instructs the system to work with a normal size playfield; i.e., 40 characters across. This location is really an O.S. shadow, however, for a hardware register called DMACTL (Direct Memory Access Control). There are two electrical switches between Antic, CTIA, memory, and the world, which tell them whether to do automatic DMA or let you do all the work. DMACTL is one, GRACTL (Graphics Control) is the other. Both switches must be on for P-M DMA to occur. This POKE turns on DMA by poking DMACTL, so now all Antic is waiting for is the GRACTL switch to be switched on.

Listing 7.

```
10 DIM A$(10),B$(100)
20 GRAPHICS 8
30 POKE 559,62
40 POKE 53248,120
50 POKE 704,88
60 I=PEEK(106)-8
70 POKE 54279,I
80 POKE 53277,3
90 POKE 53256,3
100 J=I*256+1024
110 FOR Y=J+120 TO J+137
120 READ Z
130 POKE Y,Z
140 NEXT Y
150 FOR X=48 TO 221:GOSUB 500:
    NEXT X
160 GOTO 150
320 POKE Y,Z
500 POKE 53248,X
510 RETURN
600 DATA 60,60,60,60,60,60
610 DATA 255,255,255,255,255,255
620 DATA 60,60,60,60,60,60
```

And now, for another brief detour. DMACTL also controls whether Antic can go to memory at all, as in whether he can generate display list graphics. A POKE (DMACTL),0 will turn your screen completely off, because Antic can no longer fetch bytes from memory.

Now why would we ever want to do this? For one thing, it is a good way to flash something on screen. Another is that if we change display lists, we want Antic turned completely off so that he can't run wild between them in the time it takes to POKE both bytes of a new DL start address.

Line 40 is a POKE to Player 0's horizontal position register, putting the player at 120. Line 50 POKEs Player 0's O.S. shadow register to a pink color. (No surprises so far, right?) Now, you'll recall we need 256 bytes for our table. I hate to tell you this, but if we're going to run one player this way, we have to run them all this way, which means four players and one missile times 256 bytes. There's some wasted space, so the total comes out to 2048 bytes for our bitmaps of the player missile stripes. We'll fetch the 2048 bytes at the end of available user memory. To do this, we find where the Atari thinks the end of memory is, which it figures out upon startup, and then back up 2048 bytes from there. We do this by looking at location 106, which tells the number of 100 hex, or 256-byte, "pages" of memory it has available. Since 2048 is 8 x 256 bytes, we use that value to tell the Atari where the beginning of our Player-Missile data tables will be. We POKE that location into 54279, which is "PMBASE," the base address of the Player-Missile data.

Table 3. P-M Table Area.

PMBASE * 256 = start of this area

BASE ADDRESS	
+ 0	– wasted space.
+ 767	
+ 768	– Missile Data. Missile data is packed side by side, 4 missiles of 2 bits per byte. M3 : M2 : M1 : M0
+ 1023	
+ 1024	– Player 0 bitmap. Top byte is top line of TV (above viewing area).
+ 1279	
+ 1280	– Player 1 bitmap.
+ 1535	
+ 1536	– Player 2 bitmap.
+ 1791	
+ 1792	– Player 3 bitmap.
+ 2047	

Next, we must POKE into a switch known as GRACTL. GRACTL and DMACTL, remember, are the switches that keep P-M graphics off. We already turned DMACTL on at the start of the program. We POKE a 3 into 53277, which translates to, "Turn Player-Missile graphics on and enable Antic to start getting bytes from memory." You've seen 53256 before; this is player 0's size register. A 3 POKEd in there means size times four.

Well, our player-missile graphics are now running. Whatever junk is in memory at this point is being busily pulled out of memory by Antic, fed to CTIA, and displayed on the TV. We had best put some sort of bit pattern in the table, so let's do that now. Line 280 sets J equal to

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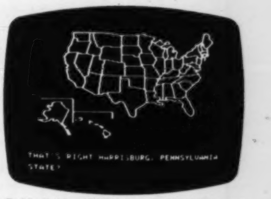
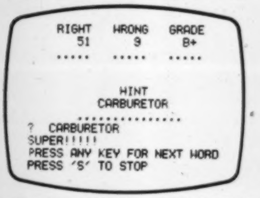


```
THAT'S RIGHT HARRISBURG, PENNSYLVANIA
STATE?
```

U.S. Map. Identify states and their capitals.



```
RIGHT    WRONG    GRADE
 51        9       B+
.....    .....    .....

         HINT
      CARBURETOR
    ..............
?  CARBURETOR
SUPER!!!!!
PRESS ANY KEY FOR NEXT WORD
PRESS 'S' TO STOP
```

Spelling. Study aid with your list of troublesome words.

```
8 + 1 = 9
WOW!!!
```

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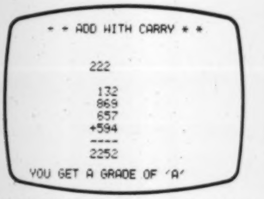

```
* * ADD WITH CARRY * *

         222

         132
         869
         657
        +594
        ----
        2252

YOU GET A GRADE OF 'A'
```

Add With Carry. Drill and practice on sums requiring numbers to be carried.

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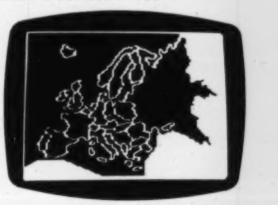
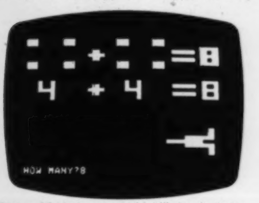


European Map. Identify countries and their capitals.



```
HOW MANY?8
```

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Atari, continued...

I (which you will recall was the start of the P-M table) * 256 (because that value was in 256 byte pages). Thus, J points to the beginning of the P-M table in real memory. We add 1024 to it, because that's how far in this table the Player 0 data is, with the data for the other players and missiles around it. (See Table 3.)

Hence, J now equals the beginning of the Player 0 data. The FOR loop in the program runs from J+120 to J+137, which is from the 120th to the 137th byte in the middle of the player, or right about midway down the screen. We read in data and POKE it into the middle of the player bit map. This data is in the form of a "cross," where the 60's are: 00111100, and the 255's are 11111111. This data will be output in the form of dots for 1 bits and blanks for 0 bits, so at this point we have a cross onscreen, still in pink. Next, we have a loop which POKEs the horizontal position register from 48 to 221, and over again. This will move our player stripe, with all but the cross on it invisible, across the screen. (Figure 4.)

There shouldn't be much mystery left in players and missiles now. Antic is just poking our hardware graphics register for us, with a table of data we feed him, so the 6502 isn't kept busy. We still move him horizontally as always, set his color, and select his size the same way. To move him vertically, we have to re-POKE the data in the byte table, and here a clever program in the April "Outpost: Atari," page 195* may help you: The data in a string are specified as the data in the player field, so by manipulating the string, you manipulate the player (at high speed). This is very valuable when you try copying a list from Basic and see just how slow it really is.

There are many options open to us, some of which you may never use, but some of which may be just the ticket for displays you're thinking of. I'll try to go over one of these options, now that we have a bare-bones P-M example going and the basics down, in a later article. You may also want the information on the Atari hardware registers which has appeared recently; it will give you the exact patterns needed to POKE into such areas as DMACTL or a size register.

Now that you have the essential information about player missile graphics, you may wish to experiment with moving players around on the screen. Listing 8 will display the horizontal memory pointers. Listing 9 will demonstrate vertical scrolling. Listing 10 combines horizontal movement with vertical scrolling, and Listing 11 demonstrates vertical scrolling combined with altering the display list in a text mode. Have fun, and be sure to experiment! ☐

---

*(Note: there is an error in line 580, which should read 580 POKE VTAB+7,1.)

Listings for Programs 1-4 were inadvertently omitted from the August "Outpost: Atari." They are listed below.

Program 1.

```
10 REM PROGRAM 1. HORIZONTAL
20 START=PEEK(560)+256*PEEK(561)
30 REM ANTIC DISPLAY MEMORY POINTER
40 REM IS AT START+4 AND START+5
50 REM
100 X=PEEK(START+4)+256*PEEK(START+5)
110 PRINT "START OF DISP MEMORY=";X
200 FOR Y=X TO X+80
205 PRINT "POINTER=";Y
210 REM SPLIT Y UP INTO TWO BYTES
220 YHI=INT(Y/256)
230 YLO=Y-(YHI*256)
240 POKE START+4,YLO:POKE START+5,YHI
250 FOR DELAY=1 TO 20:NEXT DELAY
260 REM
270 NEXT Y
```

Program 2.

```
10 REM PROGRAM 3. VERTICAL AND HORIZ
20 START=PEEK(560)+256*PEEK(561)
30 REM ANTIC DISPLAY MEMORY POINTER
40 REM IS AT START+4 AND START+5
50 REM
100 X=PEEK(START+4)+256*PEEK(START+5)
110 PRINT "START OF DISP MEMORY=";X
130 REM
140 REM SCROLL UP
200 FOR Y=X TO X+(40*20) STEP 40
210 GOSUB 1000
260 REM
270 NEXT Y
500 REM SCROLL DOWN
510 FOR Y=X+(40*20) TO X STEP -40
520 GOSUB 1000
530 NEXT Y
550 REM
600 REM SCROLL LEFT
610 FOR Y=X TO X+40
620 GOSUB 1000
630 NEXT Y
640 REM SCROLL RIGHT
650 FOR Y=X+40 TO X STEP -1
660 GOSUB 1000
670 NEXT Y
680 GOTO 140
990 REM CALCULATE HI, LOW BYTES
1000 YHI=INT(Y/256)
1010 YLO=Y-(YHI*256)
1030 POKE START+4,YLO:POKE START+5,YHI
1040 RETURN
```

Program 3.

```
10 REM PROGRAM 2. VERTICAL L
20 START=PEEK(560)+256*PEEK(561)
30 REM ANTIC DISPLAY MEMORY POINTER
40 REM IS AT START+4 AND START+5
50 REM
100 X=PEEK(START+4)+256*PEEK(START+5)
110 PRINT "START OF DISP MEMORY=";X
130 REM
140 REM SCROLL UP
200 FOR Y=X TO X+(40*20) STEP 40
210 GOSUB 1000
260 REM
270 NEXT Y
500 REM SCROLL DOWN
510 FOR Y=X+(40*20) TO X STEP -40
520 GOSUB 1000
530 NEXT Y
540 GOTO 140
550 REM
990 REM CALCULATE HI, LOW BYTES
1000 YHI=INT(Y/256)
1010 YLO=Y-(YHI*256)
1030 POKE START+4,YLO:POKE START+5,YHI
1040 RETURN
```

Program 4.

```
1 REM PROGRAM 4. VERTICAL SCROLL DEMO
5 VSCROLL=54277
10 START=PEEK(560)+256*PEEK(561)
20 REM *** PUT SOME DATA ONSCREEN.
30 GRAPHICS 0
35 FOR T=1 TO 24
36 PRINT "THIS IS LINE #";T
37 NEXT T
40 REM *** ALTER DISPLAY LIST TO V
45 REM *** IN TWO AREAS. 2 + 32 = 34
60 FOR Y=START+10 TO START+13
70 POKE Y,34
80 NEXT Y
81 FOR Y=START+17 TO START+20
82 POKE Y,34
83 NEXT Y
84 REM *** SCROLL UP
90 FOR Y=0 TO 7
100 POKE VSCROLL,Y
105 GOSUB 200
110 NEXT Y
115 REM *** SCROLL DOWN
120 FOR Y=7 TO 0 STEP -1
130 POKE VSCROLL,Y
135 GOSUB 200
140 NEXT Y
150 GOTO 90
160 REM *** SHORT DELAY LOOP
200 FOR T=1 TO 50:NEXT T
210 RETURN
```

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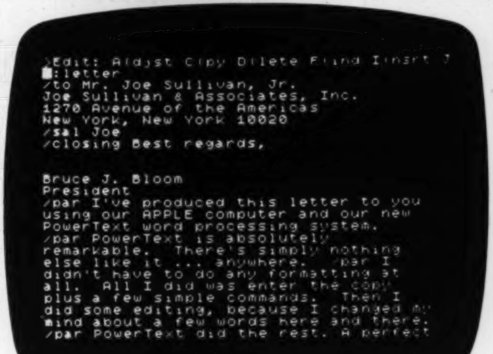

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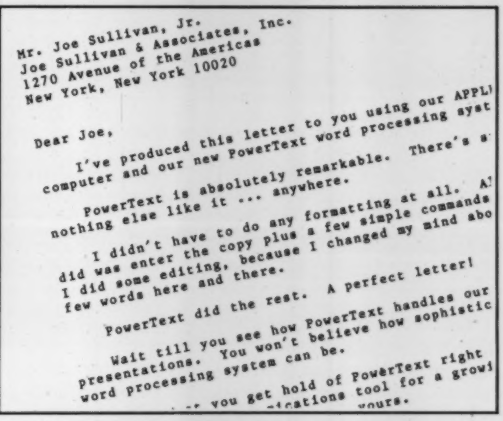

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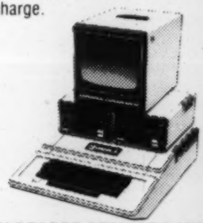

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ngs...TRS-80 strings...TRS

Stephen B. Gray

For the 33rd orbit on this merry-go-round, we'll look at a music synthesizer, a music sweetener, an audio tape that helps you compare two synthesizers, a compiler-demonstration tape, a 3D graphics program, and a short program to help you pack strings.

The Music Box

If you play a keyboard instrument (musical, that is), there are probably many pieces you'd like to perform, but which are beyond your capability, because they're too difficult to play.

Sometimes a piece is impossible to play because it isn't available in a keyboard version. One example of this is the *Canon for String Orchestra*, by Johann Pachelbel (1653-1706), which has enjoyed a new popularity recently. Although it has no known programmatic connotations, "Its serene simplicity has given it a certain spiritual mystique," according to the jacket notes on one album featuring it.

Although originally written for organ, it seems to be available now only for three violins and continuo. Which means you can rewrite it for the organ or piano, by combining the three violin parts, or get three violinists to help you play it.

Or you can write it in the simple language of the Music Box, a music synthesis program, and the canon will be played back much more precisely than you could ever do it yourself on any instrument.

The Music Box, by Musicraft, is $149.95 from Newtech Computer Systems Inc. (230 Clinton St., Brooklyn, NY 11201). It consists of a plastic box, about 7" by 5" by 2 1/2", silkscreened with a keyboard motif, containing a latching digital-to-analog converter followed by a low-pass filter and audio amplifier, plus a ribbon-cable connector (which plugs into the 32K single-disk expansion interface on your TRS-80), power supply, demo disk, and Music Program disk.

The Music Box

Disk Only

The Music Box was originally available on both disk and cassette, but the cassette version was dropped because users had to spend too much time loading each of the five program modules separately, one after another, after another, after another, etc. With disk, all five modules are available instantly—well, almost instantly.

First you call up the EDIT module, which you use to enter music, either transcribing it from written notes, or composing as you go. Or you can change music already stored.

At the beginning of EDIT, you either load what the manual calls a "song," to be edited in some fashion, or write a new "song." You enter the number of voices, from one to four, then call up the menu of options, which lists half a dozen, from setting the number of intervals per octave (for microtonal music, you can use from 1 to 99 intervals per octave) to changing the tempo.

You enter tempo and key, then start entering the notes and their durations, one voice at a time. For the bar of the canon in which the first violin comes in, you write

```
0002 Q   F#5
0003 Q   E@5
0004 Q   D@5
0005 Q   C#5
```

The line numbers are displayed automatically, as is the # sharp sign and the @ natural sign. You enter Q for quarter-notes, and 5 for the octave they're to be played in.

Voices 2 and 3 have to be accounted for, even if they're not heard, so you fill in the blanks with rests. For example, in the third bar in which the violins are heard, only violins 1 and 2 are played, so violin 3 is indicated with rests:

```
0012 Q   D@5   F#5   R@5
0013 Q   C#5   E@5   R@5
0014 Q   B@5   D@5   R@5
0015 Q   A@5   C#5   R@5
```

Because this is a canon, the second voice, which starts at line 0012, uses the same notes as the first voice that began at line 0002. How nice it would be if you only had to write the first voice, then tell the program to uses the same notes for the second voice, only starting two bars later, and the same for the third voice. However, I've heard that the only personal-computer music synthesizer that can do this is the ALF, which is designed for the Apple computer.

After entering your song, you compile it, which will give you a playable song file. Call up COMP, enter the name of the song to be compiled, and the module translates the song lines into the numerical values required by the PLAY module.

Then you write the compiled song onto disk, and call up the PLAY module, which enters the waveform-load sequence. You can either call up a waveform you've built with the WAVE module (which uses Fourier synthesis), or use the pre-loaded waveforms, and your song is played right away.

A fifth module, UTIL, permits working up a "jukebox" menu of songs, printing out the music, transmitting a song or a wave form via the RS-232 port, etc.

The Music Box has many more capabilities than space permits describing here, such as calling a chorus, repeating phrases, transposing, extensive editing commands, etc. You can practice an instrument by writing a song and then playing it back with a single voice missing; you play along with the other voices, just like Music Minus One records.

PLAY offers an interactive option, allowing you to use the TRS-80 keyboard as a programmable interface. In EDIT mode you assign a note or chord or melody to a key, and later, as a song is being

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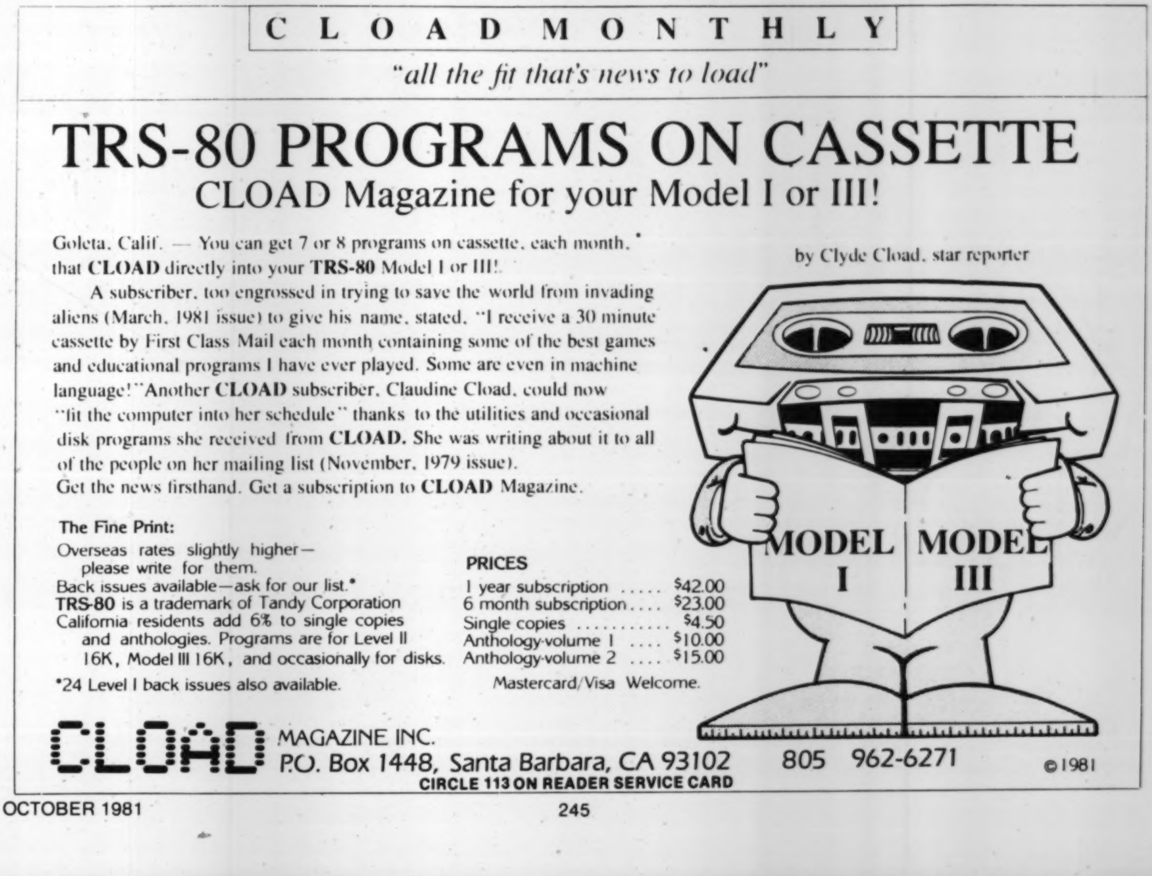

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by Clyde Cload, star reporter

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A subscriber, too engrossed in trying to save the world from invading aliens (March, 1981 issue) to give his name, stated, "I receive a 30 minute cassette by First Class Mail each month containing some of the best games and educational programs I have ever played. Some are even in machine language!" Another **CLOAD** subscriber, Claudine Cload, could now "fit the computer into her schedule" thanks to the utilities and occasional disk programs she received from **CLOAD.** She was writing about it to all of the people on her mailing list (November, 1979 issue).
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played, press a key you have pre-assigned and, right in the middle of whatever is being played, the note or chord or melody will be heard. That could make for some very interesting music...

The major problem with The Music Box is the 91-page manual. If you're used to military manuals, with paragraph number IV.A.4.b.1.7, and have knowledge of music synthesizers and waveform-building, you can probably get a great deal out of the manual. If not, it may drive you right up the wall.

There's no simple step-by-step how-to section, so that a beginner can write simple music within a reasonable time, and then get into the more complex aspects. You're supposed to read the entire manual first, and then try to remember where to find the various bits and pieces, scattered here and there, that are necessary for running the various modules. It's more a reference manual than a how-to-manual. It has no index, gives only a sketchy idea of how to build a waveform, and provides no information in the UTIL section on how to use the RS-232 port.

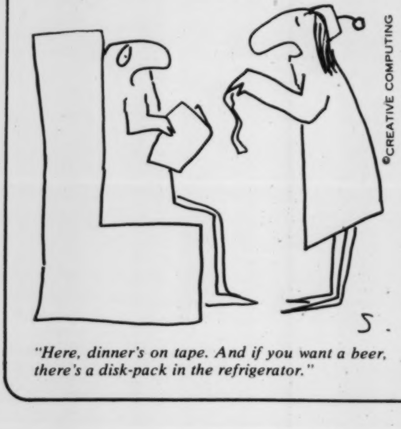
The Music Box, then, is not for the neophyte or the faint-hearted. But if you're adventurous and like a challenge, and would like to use a music synthesizer that has many excellent and versatile features, try The Music Box.

Comparison With Orchestra-80

The only other polyphonic (more than one voice at a time) TRS-80 music synthesis system, at this writing, is Orchestra-80 (Feb. 1981 p. 162).

The Orchestra-80 manual is much better, and the music easier to write, than with The Music Box. Although Orchestra-80 uses numbers for the notes in the two octaves above and below middle C, before long you begin to remember most of the numbers.

Using Music Box, I had to keep looking at the manual to find out exactly where the scales change from octave 4 to octave 5, for example. Also, since mistakes can't be changed on the spot using The Music Box (they can with Orchestra-80), I first typed out all the information for the Pachelbel *Canon* before entering it on the keyboard, to make sure I'd get it right, especially all those added rests.



"Here, dinner's on tape. And if you want a beer, there's a disk-pack in the refrigerator."

However, the proof of the synthesizer is in the music. The polyphonic music made by the two systems is basically about the same. But The Music Box contains a low-pass filter. Orchestra-80 doesn't, and its music is marred by incessant, unwanted harmonics. You can de-emphasize these high pitched squeaks with the tone controls on your amplifier, but that's at the expense of the music.

Incidentally, you can run the Music Box software on Orchestra-80 hardware, and vice-versa, although for the latter you have to change one byte in the assembly-language program. This isn't a case of a copied product; there's only one accepted technique of digital-to-analog conversion.

Music Sweetener

There's a way to get rid of those unwanted harmonics created by Orchestra-80. Newtech sells a low-pass filter, similar to the filter in The Music Box, which will remove those high squeaks, for $39.95. You can use it with any DAC music synthesizer that doesn't have a filter in it. It's called the Music Sweetener.

Synthesizer Sampler Tape

If you want to compare the two TRS-80 music synthesizers, there's a C-48 cassette tape with over two dozen selections, played by The Music Box and by Orchestra-80.

The audio tape is $3.95 postpaid, from Computer Information Exchange (CIE for short), Box 159, San Luis Rey, CA 92068. Many of the selections are played on both systems, so you can compare them directly.

Although the tape can be played on any cassette player, for best results it should be played through a hi-fi system.

The music includes a couple of Scott Joplin rags, the Bach *Prelude in C minor*, his *Fugue and Invention No. 8*, and the first movement from his *Concerto for Two Violins*. There are also selections by Handel, Bokelman, Mozart, Gounod, and Rossini, plus *Dixie* and a czardas.

On the tape, Orchestra-80 seems to be the winner, despite the unwanted harmonics, which are not filtered out. Part of its superiority is due to most of the Orchestra-80 selections having been arranged more skillfully, with more attention to the techniques that show off a synthesizer at its best.

For another thing, the Orchestra-80 selections sound mellower, which may be because of the waveforms used or perhaps because of the hi-fi system used.

Although the Orchestra-80 selections outnumber those played on The Music Box by two to one, CIE president Bill McLaughlin says, "We worked with all the material we were able to dig up, and worked mostly with material from the vendors."

Compiler Demonstration

CIE has another demo tape, which shows how a Basic or Tiny Pascal compiler can speed up your programs. The $3.95 tape, for 16K Level-II TRS-80, offers the games of Mice and Life in two versions: interpreted Basic and the compiled native code.

Mice, compiled by Southern Software's ACCEL2 compiler, runs 20 times faster than the interpreted version, which is so slow you'll soon give up.

Life runs about five times faster in the compiled version than in the interpreted version, which will put you to sleep.

The tape contains a third game, in a compiled version only: Bullseye, compiled on CIE Tiny Pascal, which is the tape systems only. ACCEL2 works on either disk or tape. Both compilers are available from CIE: Tiny Pascal is $19.95; ACCEL (for Level-II Basic) is $44.95; ACCEL2 (handles full disk Basic) is $88.95.

Sublogic 3D Graphics

RUN the demonstration side of the 3D graphics-program tape from Sublogic Distribution Corp. (Box V, Savoy, IL 61874) and you get three "snapshots" or samples of a flight simulation. A Cessna 74 is five miles northeast, traffic is a Learjet in the mountain pass about to make a low pass at runway 25, and you're cleared to land on runway 7, according to the second display.

The third display is a 3D display of half-a-dozen intersecting lines plus something that may be a mountain, not all that easy to visualize, perhaps because low-

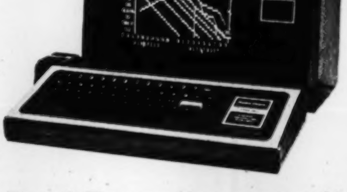


Figure 2. The screen shows a more sophisticated display than provided by the demo-tape snapshots; it's from Sublogic's T80-FS1 Flight Simulator program that runs at three frames a second.

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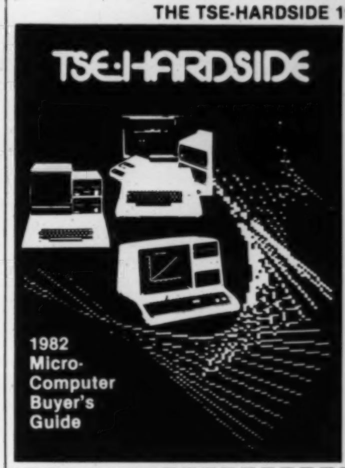

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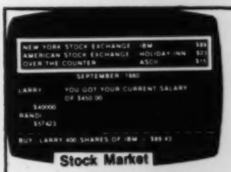

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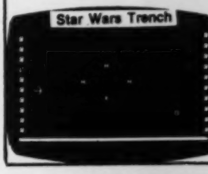

Star Wars Trench

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resolution raster-scan isn't all that great for graphics to begin with, and for 3D it can present problems.

However, the two following 3D displays make more sense, as you head toward the numbered runway.

On the other side of the $30 16K Level-II tape is the Microcomputer 3D Graphics program, with a sample database, for a cube, to help you become familiar with 3D graphics. RUN it, and you're asked for field of view, which allows you to select either wide-angle or telephoto views of the object to be viewed, which is a 50-by-50-by-50 unit cube located at the upper-right side of the X,Y origin, 100 units back on the Z axis.

Then you the enter the location of the object (X,Y,Z) as 0,0,0. For Direction of View (P,B,H), you enter data for Pitch, Bank and Heading; enter 0,0,0 for now.

The screen shows you a cube as viewed from the Z-axis. Now you can begin to move the cube around. Press ENTER, and you're asked to enter the location of the object (X,Y,Z). If you input -25,-25,0, while holding the other parameters constant, you center the view of the closest face of the cube.

To move the cube closer to you, move it in a negative direction along the Z-axis with -25,-25,-50.

To rotate the object image relative to itself, change Bank by entering 0,30,0 for P,B,H. The small 23-page manual then tells how to move the cube around by changing X,Y,Z and P,B,H data, and provides several examples.

The program redraws the cube each time; this is not dynamic graphics, which would show the cube moving from one aspect to another. That takes much more memory and a longer program, because you've got to display all those intermediate views.

Experience with different entries will give you the ability to judge the P,B,H necessary to view the object, according to the manual, which goes on to show how to create and enter your own database for any image you wish. You sketch the object on paper first, label points, organize the database, and enter start and end points, replacing the data in program lines 2000-2033 (or more, if necessary) with your own. The booklet ends with a listing of the program.

A larger and longer manual, the 60-page Basic 3D Graphics Manual, goes into detail, explaining 3D concepts, moving objects in 3D, the 3D program, etc. Everything is explained as simply as possible, without math in the main text. Appendix 2 gets into the graphic principles of point translation using tranformation matrices, without getting too heavy on the math.

The projection method, by the way, is "3D to 2D wire-frame perspective transformation with 3D clipping."

Appendix 3 describes (although without showing how) using 3D graphics in flight simulation (another Sublogic package), computer art, architectural design, engineering drawing, etc.

Sublogic leaves to the imagination of the user the details of how to carry out such projects, which are only a few of the vast number of projects possible, with side areas such as removing hidden lines, adding shadows and surface textures, etc.

```
1 CLS:DIM B$(10)
10 PRINT CHR$(23): PRINT @ 524,"THE STRING PACKER"
20 FOR I=1 TO 700: NEXT I: CLS: PRINT CHR$(12)
30 B$(1)=".............................."
40 B$(2)=".............................."
50 B$(3)=".............................."
500 INPUT "ENTER THE ARRAY NO. FOR 'B$(?)'";Z
510 L=PEEK(VARPTR(B$(Z))+2)*256
520 R=PEEK(VARPTR(B$(Z))+1)
530 N=L+R
540 FOR X=1 TO 30
550 IF D=1 GOTO 570
560 PRINT X;: INPUT "ENTER THE DEC. NO.";D
570 POKE N+X-1,D
580 PRINT B$(Z)
590 NEXT X
600 D=0: GOTO 500
1000 REMARKABLE PROGRAM BY BILL RADABAUGH--1/29/81
```

Short Program #22: String Packing

Bill Radabaugh of St. Marys, OH, sent a program that shows you what a line of string-packed graphics characters looks like while you're creating it:

"After reading your article in the Jan. 1981 column (p. 164), I began experimenting with the string-packing technique. After running the program a few times and packing some strings for some simple graphics, I noticed that there were some things that could help the program work better.

"First, there was the time in writing out all the data for each string. This problem was easily solved by putting an input for each character. I made the string into an array so that many strings could be made with one run of the program.

"The next problem was the spaces involved with the strings. To insure that I had enough spaces between the quotes, I simply put in the most that I would need in each string; then, to get rid of the spaces left when all of the characters were packed, I entered 1 for the decimal number. This puts the program in a loop and zaps the rest of the spaces, since there is no character represented by the 1.

"In the program, lines 30, 40 and 50 have been put in as examples. Actually, the strings can be put on any line. The more strings you want, the more you will have to DIM B$.

"Be sure to put enough spaces, and change the FOR/NEXT loop in line 540 to the new number. One good thing about the program is that if you wish to change a string you have already packed, you can do so as many times as you want.

"P.S. One more thing. Be sure to use the same number of spaces in each string, or you might end up poking away the parts of the program."

RUN the program, which first asks for the array number that, in this program, is 1, 2 or 3. Then you're asked to enter the graphics codes for that array.

If you enter 1, and then 183, 179, 179, 187, 128, 183, 179, etc., the line of periods will be replaced one by one, with the graphics characters that make up a line of boxes. Then, if you LIST the program, you'll find that line 30 is no longer a line of periods, but has been string-packed:

30 B$(1)="AUTOCONTCONTNEW ENDAUTOCONT etc."

so that if you type

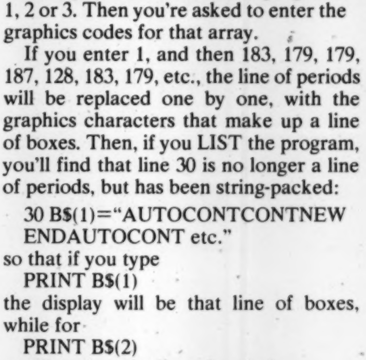
PRINT B$(1)

the display will be that line of boxes, while for

PRINT B$(2)

you'll get just the line of periods.

This program has some interesting characteristics, which you'll discover when you try to change part of a packed string, or enter a few codes and then just keep on pressing ENTER instead of entering more codes. ☐



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Other factors are choice of routes, truck payments, fuel, food, tolls and fines. The simulation is engrossing and informative.

Streets of the City

This simulation is modeled on Grand Rapids, Michigan, a metropolitan area with a population of 550,000. The budgeting, cost and work standard bases are derived from actual experiences of the city over the past five years. The objective of the simulation is to complete a ten-year plan of street and transit improvements while retaining the support of a majority of the City Commission.

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Other factors to be considered are operating tax levies, construction bonding and labor negotiations. The simulation provides a substantial challenge and it is both educational and entertaining.

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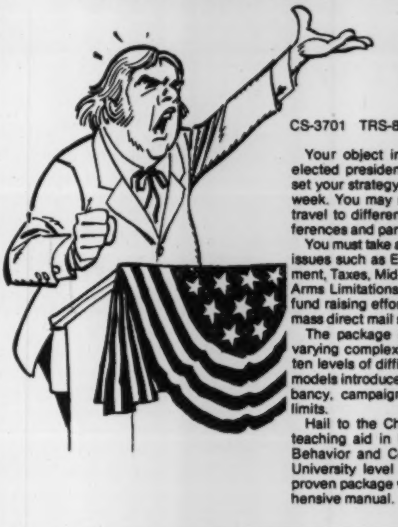

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David Levy

Correspondence is welcome. Letters with interesting questions and ideas will be used in the column along with a response. No personal replies can be made. Send to: David Levy, 104 Hamilton Terrace, London NW8 9UP, England.

Contract Bridge is one of the most interesting and skilful of card games, ranking alongside poker in its complexity. Many computer programmers are also bridge enthusiasts, so I expect that many of my readers will, at some time or another, have considered the possibility of writing their own bridge program. Let me warn you from the outset — this is a most daunting task. I would expect a competent programmer to take three times as long to write a bridge program as to write a fairly respectable chess program, and the size of the bridge program would be much larger — with less than 32 kbytes you might as well forget it. But since most of you who own or have access to computers *will* have at least 32k at your disposal, writing a bridge program is a task that can be undertaken by anyone who is prepared to devote a lot of time and effort.

In writing about computer bridge I shall attempt only to outline some simple principles which will enable the reader to write a working program. The game is sufficiently rich in ideas that stronger bridge players will be able to extrapolate from my article and include a number of more advanced concepts in their programs. Anyone who writes a 'simple' bridge program based on these articles will be able to enjoy an undemanding game without the need to find three other (human) players.

How to play bridge

I do not wish to go into a detailed description of the rules of the game, but some of my readers may not know how to play, so some explanation is essential. This will also enable those of you who play other bidding games to learn the principles of programming the bidding phase, which can be carried over to other games. The principles of playing the cards might also be useful in programming other games which are based on taking tricks. So don't give up if you are not attracted to the idea of programming bridge — what you learn here may help you in other games.

Contract bridge is played by four players, who form two partnerships. A normal deck of 52 cards is used, and at the start of a hand each player is dealt 13 cards. The players start by bidding for the right to play the hand, and whichever side makes the highest bid then tries to make the number of tricks indicated by that bid. If the partnership is successful in making the desired contract it scores points according to the size of the bid, and the number of extra tricks (overtricks) made by the partnership. If the contract is not made, the partnership which was playing to make the contract loses penalty points, the number of penalty points depending upon the number of tricks by which the contract failed, and whether or not the defending partnership decided to 'double' the contract (doubling, as one might expect, doubles the number of points gained or lost on a hand, and also affects bonus points which can be scored in certain situations).

The player who deals the cards opens the bidding. He may say 'pass' or 'no-bid' if he doesn't wish to make a positive bid at this stage, or he may make a bid of the form 1 Club, or 2 No Trumps — the number part of the bid indicates the number of tricks that must be made if this bid is the final contract (number of tricks = number bid + 6); the suit part of the bid indicates what will be the trump suit if this bid is the final contract.

After the first player has made his bid or passed, it becomes the turn of the player sitting to his left. This player may also pass; or he may make a higher bid; or he may double the opponent's previous bid. In order to make a higher bid he must indicate a greater number of tricks, or he must bid a higher ranking suit (or no-trumps) than the previous bid. The ranking of the suits goes (from lowest to highest) Clubs, Diamonds, Hearts, Spades and then comes No-Trumps. So one Heart is higher than one Diamond; one No-Trump is higher than one of any suit; and two Clubs is higher than any bid at the one level.

The bidding proceeds in this way, moving round the table in a clockwise direction and coming to an end only when three successive players pass. Even if a player doubles or redoubles an opponent's bid, there must then be three successive passes before the bidding is at an end. Once the bidding is over, the players who won the bidding (ie made the final bid) are obliged to play the contract, or to be more precise, whichever of them first bid the suit (or No-Trumps) of the final contract — he is the one who must play the cards for his partnership. He is referred to as 'Declarer' and his partner as 'Dummy',

The player on the declarer's left leads any card that he chooses and, at this point, dummy places all of his cards on the table, face up so that everyone can see them. From now on dummy has nothing to do until the hand is over. His partner, declarer, must play the cards for both of them.

The rules of play are very similar to those of Whist and many other trick-taking games. The player who wins one trick leads the first card to the next trick, and players must follow suit if possible, or if this is not possible they may trump a card if they possess any trumps. (In a No-Trump contract this is not applicable.) Cards rank in the usual order, from Ace, King, Queen and Jack down to 4, 3 and 2.

The bidding phase

The point of the bidding phase is to try to reach the optimal contract, partly by conveying information to your partner about the strength and 'shape' of your hand. In order to be able to determine what contract you and your partner should be playing, it is important for you to know something about each other's hand. This is accomplished by the bidding, but because every bid must be higher than the previous bid, a partnership does not have a completely free license to pass information back and forth during the bidding, as this would lead them into an impossibly high contract. So the most important thing to do during the bidding is to try to reach the ideal contract by conveying the maximum

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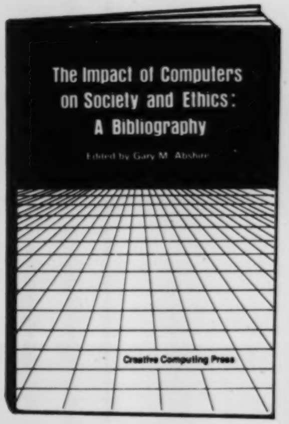

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Edited by Gary M. Abshire

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Compiled by Gary M. Abshire. Hardbound, 128 page. $17.95. (12E)

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	Spades: K 8 7 4 2 Hearts: 2 Diamonds: A J 9 5 3 Clubs: K 10	
Spades: 10 Hearts: Q J 10 7 6 Diamonds: Q 8 2 Clubs: Q J 4 3	N W E S	Spades: 9 5 Hearts: K 9 4 Diamonds: K 10 7 Clubs: A 9 8 6 5
	Spades: A Q J 6 3 Hearts: A 8 5 3 Diamonds: 6 4 Clubs: 7 2	

information about your hand in the most economical manner. Let us examine the bidding of a hand of bridge to see how information is conveyed.

For the sake of convenience we usually refer to the four hands by the four points of the compass: North, South, East and West. We shall assume that West was the dealer, and that the bidding goes like this: (players' thought processes in brackets).

West: Pass (I have a weak hand);

North: One diamond (I have a stronger-than-average hand with two good suits. I shall bid the lower ranking suit first to give my partner a chance of bidding hearts at the one level);

East: Pass (I also have a hand that is no better than average, and since my partner is weak we will not have enough combined strength to make any contract);

South: One spade (I have two biddable suits, but I have more spades than hearts so I shall bid spades first);

West: Pass;

North: Two spades (My partner has at leat four spades in his hand so we at least nine spades out of 13 between us. Obviously spades will be a good suit for us to play a contract in);

East: Pass;

South: Three hearts (I must show my partner that I have another biddable suit);

West: Pass;

North: Three spades (My first spade bid indicated only that I had reasonable spade support for my partner. Now I should tell him that I have more than minimal spade support and that I do not have enough strong cards in the unbid suits to make a no-trump contract possible);

East: Pass;

South: Four spades (My partner has at least four spades and probably holds the king of spades. He also has four or five diamonds so he does not have many clubs and hearts. I have the Ace of hearts so we are unlikely to lose more than one heart trick, and I only have two clubs so we cannot lose more than two club tricks before I can trump any further clubs that are led. So we ought to be able to avoid losing any more than three tricks, and four spades seems quite possible);

West: Pass;

North: Pass (Enough is enough);

East: Pass.

The above bidding and thought processes represent an over-simplification of what was going on in the minds of the players. But it does serve to explain the type of thought processes that one goes through when bidding in a simple fashion. I ought perhaps to mention at this stage that by reaching certain contracts a partnership may qualify for a 'game bonus' if the contract is made. These game contracts are: 3 No-Trumps; 4 Hearts or 4 Spades; 5 Clubs or 5 Diamonds. Making a lesser contract allows you to score the game bonus later on if you can make another contract that counts, together with the earlier contract, for enough points to make a game. I will not go into the scoring system in this article, but you should study an elementary book on bridge before writing your program, so that the scoring will be correct.

In order to make the bidding phase easier and to ensure that information is conveyed economically, various bidding systems have been invented. In a bidding system, each bid has a fairly precise defined meaning, and by correctly interpreting a bid, a player will understand more about his partner's hand. One useful tool employed in many bidding systems is what are known as 'high card points'. This points method usually counts 4 points for holding an Ace, 3 for a king, 2 for a queen, 1 for a jack or singleton (a suit with only one card, other than an Ace), 4 for a void (a suit with no cards), 1 for each card after the first five in a suit. Using this point count method, various rules of thumb have been developed, including:

a) Do not open the bidding with fewer than 12 points;
b) If you hold 12-15 points you should open one of your best suit.
c) If you hold 16-18 points you should open one No-Trump.
d) In order to make a three No-Trump contract the combined hands should have not less than 24 points, preferably 25 or more.

The above rules can all be broken, under the correct circumstances and, in fact, the same bid can mean many different things in the same situation, depending on which system of bidding the partnership is employing. The most important thing to remember about bidding is that bridge is a partnership game, and you should be trying to help your partner during the bidding by making meaningful bids that he will understand. There is no point in making a brilliant bid on one bidding system if your partner is using a different system — he will not understand what you mean and before you know what is happening you and your partner will have overbid, and found yourselves in an impossible contract.

How to program a bidding system

Before writing your program, decide what bidding system will be used in the program and make a long list of what the various bids can mean in different circumstances. Whenever the program must make a bid it determines the circumstances and makes the appropriate

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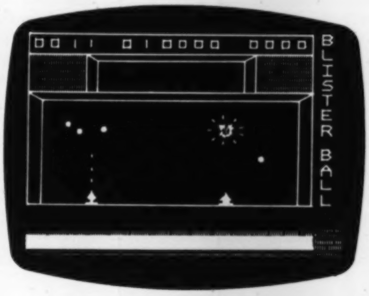

How does it work? Well, some mean but fun-loving aliens have produced some bouncing bombs. First they drop one and you've got to position yourself under it and zap it with your laser. If you miss, that's OK. It will bounce around, although each bounce is lower, and you have several chances to zap it. Got the hang of it? OK, here come two bouncing bombs. You zap them. Then you're faced with three, then four and five.

As they bounce longer and longer the walls begin to close in so you're faced with either zapping the bombs or being hit. Each hit knocks you a little further toward the gutter. But you can survive two hits which is usually enough to zap all the bombs.

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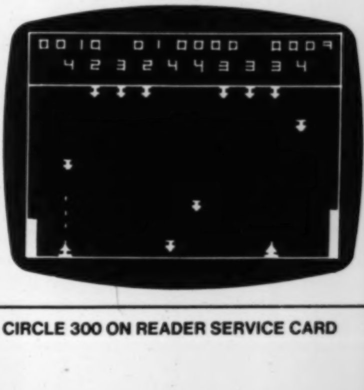

As the game progresses, the aliens fill up their bomb racks more quickly and the bombs fall faster. You lose after ten bombs have hit the area which you are defending.

Mad Bomber can be played by one player solo or by two players as a team or as opponents. Two skill levels.

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bid. Whenever the program must interpret a bid made by its partner, it determines the circumstances under which the partner's bid was made, and then looks at the list of bids to see what the particular bid should mean in those circumstances. These two processes, the making of the correct bid and the interpreting of the partner's bid, can each be aided by keeping a number of important variables and updating them in the light of new information transmitted or received. The following variables might usefully be employed when deciding what bid to make or when interpreting a bid made by one's partner:

Max Clubs (what is the maximum number of clubs that have been shown so far by the player who is bidding this hand);

Min Clubs (the minimum number of clubs shown by the bidding);

Max Diamonds
Min Diamonds
Max Hearts
Min Hearts
Max Spades
Min Spades

By storing values for all the above variables, the program can build up an idea of the way in which the suits are distributed in his partner's hand, or he can keep track of the extent to which he has described the distribution of the suits in his own hand. In addition to knowing how long a suit might be, it is also very useful to have some indication as to how strong a particular hand might be.

This can be accomplished using two variables called Max Points and Min Points, which indicate the known limits of strength of a hand as indicated by the number of high card points in the hand. For example, if a partnership is using a bidding system in which 13 points is the minimum number for making an opening bid, a player who makes an opening bid is known to have at least 13 points so his Min Points is initially adjusted from 0 (the default value when the hand is dealt) to 13.

Adjusting the distribution variables is not a particularly difficult matter. At the start of a hand the four Max variables are set at numbers which may be deduced from the holding of the hand under scrutiny. For example, if the computer is making the first bid for West in the above hand, it sets Max Spades for North, East and South at 12, since it has one spade and knows that no other player may therefore have more than 12. Similarly, Max Hearts is set at 8, Max Diamonds is 10 and Max Clubs is 9. The minimum values of the suit variables are all set at 0 since no bids have been made and therefore nothing is known about the distribution in each of the hands other than the program's 'own' hand.

If we follow through the bidding of the above hand again, assuming that the computer is playing South, we can see how easy it is to adjust the distribution variables for the other hands. (Here I shall make certain assumptions concerning the bidding systems employed by the N-S pair and the E-W pair.)

West: (West's Max Points is set to 1, as he would open the bidding on 12 or more). West's Min Points remains at 0.

North: One diamond (North's Min Points is set at 12, Max Points is set at 15, since with 16-18 points North would have opened one No-Trump, and with 19 or more he would have opened two of a suit.) Also, Min Diamonds is set at 4, the minimum number needed to bid, and Max Diamonds is set at 7, since with 8 he would have opened higher.)

East: Pass (East's Max Points = 11, Min Points = 0)

South: One spade (South, the program, has indicated that he holds at least 7 points, otherwise he would have passed. So Min Points = 7, Max Points = 11, otherwise he would have made a stronger bid to indicate that he, too, held an opening hand. Min Spades = 4 and Max Spades = 6, since with seven or more spades, South would have made a stronger bid than one spade.)

West: Pass

North: Two spades (Min Spades = 3, Max Spades = 5, since with six or more spades North would be able to bid higher in spades, and would have opened in spades rather than diamonds. Also Max Hearts = 4 and Max Clubs = 4, by subtraction from 13.)

East: Pass

South: Three hearts (Min Hearts = 4, Max Hearts = 6 and, by subtracting from 13, we find that Max Diamonds = Max Clubs = 4. Note that neither clubs nor diamonds can be longer than a four card suit, as this would have required South to bid the suit before now.)

West: Pass

North: Three spades (Min Spades = 4)

East: Pass

South: Four spades (Min Spades = 5)

This example is not intended to indicate exactly how the variables should be adjusted, nor is it intended to be complete in the summary of information conveyed by each bid. The sole *raison d'etre* for the example is to show the reader the type of information that can be gleaned from a bid, and how this information may be used to update some of the more useful variables. When you have decided on the bidding system that will be employed in your program, the method for updating each of the variables will suggest itself.

Special Conventions in Bidding

There are a number of special bidding conventions, each of which may be used in a particular situation. Often these conventions take the form of a question and an answer. For example, the Blackwood convention is a method of asking your partner how many aces he holds, and how many kings. This information is particularly useful if your partnership is hoping to make a small slam (12 tricks) or a grand slam (13 tricks). The asking bid in Blackwood is 4 No-Trumps, and the replies are:

5 clubs, when holding no aces (sometimes this reply is given when holding all four aces);
5 diamonds, when holding one ace;
5 hearts, means two aces;
5 spades, means three aces.

In order to ask how many kings your partner has you simply bid five no-trumps, and he bids the number of kings at the six level (6 clubs is 0 or maybe 4), 6 diamonds is 1, etc.

When the Blackwood convention is employed, the program can update variables such as: Number of Aces, Number of Kings, and the tri-state variables Ace of Clubs, Ace of Diamonds, etc, which can indicate yes, no or don't know, depending on what may be deduced from the bidding. For example, if you hold two aces and find that your partner holds the other two, you know which aces he holds and so you can set the values of the tri-state variables (Ace of Clubs, etc) accordingly. This detailed use of variables can be most helpful when making a slam decision.

Another popular convention is known as Stayman, and consists of a two club asking bid after your partner has bid one no-trump. The asking bid enquires whether partner has at least four cards in either hearts or spades (or both), in which case he should respond by bidding the appropriate suit (or the better suit if he holds at least four cards in each of the two suits). If the program asks this question of its partner, it can use the reply to update the variables Min Spades, Max Spades, Min Hearts and Max Hearts, according to the reply bid.

Deciding What to Bid—a Simple Algorithm

When faced with the decision of what bid to make, a number of complex factors enter the thought processes of a good bridge player. Here we are discussing the problems of writing a relatively simple bridge program, and so we must try to employ a relatively simple bidding algorithm. I have devised such an algorithm, which lacks the subtlety of an advanced bridge player, but which ought to provide the computer with the ability to make bids that are reasonably intelligible and reasonably sensible. The algorithm applies to any bidding system, so you may choose any system that you like, preferably from a good book on bidding. One word

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of advice — try to use a 'natural' bidding system (one in which the bids tend to reflect the obvious features of the hand) rather than an 'artificial' system (in which most of the bids form an apparently obscure code).

Most books on bidding will offer advice on how many high card points are needed to make contracts at various levels. In 'Bridge for Beginners' (by Victor Mollo and Nico Gardener), for example, we find that a useful guideline is:

22-25 points are needed in the combined hands to make any contract
26 points are needed to make 3 No-Trumps, 4 Hearts or 4 Spades, or 5 Clubs or 5 Diamonds
34 points are needed to make a slam (12 or 13 tricks)

These guidelines are extremely useful, inasmuch as they can set an upper limit on the program's bidding. In our earlier example, once the program knows that it and its partner (playing North-South) hold less than 34 points, which is when the second bid is made (South's one Spade), it is immediately obvious that a slam is not a real possibility, so the maximum contract is a game contract and the highest possible bid is 5 Diamonds).

The manner in which the algorithm operates is simplicity itself. The program first asks the question 'can I bid again without exceeding the safe limit?', where the safe limit is defined by the above guidelines. If the answer to this question is 'yes', the program simply examines every one of its legal bids, determines what would be meant by each of these bids, and then performs some sort of matching exercise to produce a numerical score that represents the accuracy with which each bid describes the hand (bearing in mind what has already been bid). In a situation where the program is responding to an asking bid (eg, Blackwood or Stayman) there is no problem — the program simply gives the correct answer to the asking bid. But in the general case the program must evaluate each bid and then choose the bid with the highest score, or, if two or more bids have a similarly high score, the program selects the lower bid so that it can convey information in an economic manner.

How exactly this matching procedure is programmed will depend entirely on the type of bidding system you employ in your program, but a few hints may be useful for setting you on the right track. Firstly, we should consider a situation in which the program ought to make an asking bid. This might happen when it has discovered that it and its partner have 34 points or more between the two hands. The program may wish to know how many aces and kings are in its partner's hand (unless it has all the aces and kings itself), in which case it bids 4 No-Trumps. If the answer indicates that its partner has all the missing aces, the program can then ask how many kings are in its partner's hand. It will then find out whether the partnership is missing any of the important top cards and make its decision as to whether it can afford to bid 7 (for a Grand Slam) or only 6 (a Small Slam). Asking bids and their responses are as easy for a computer program as for a human player.

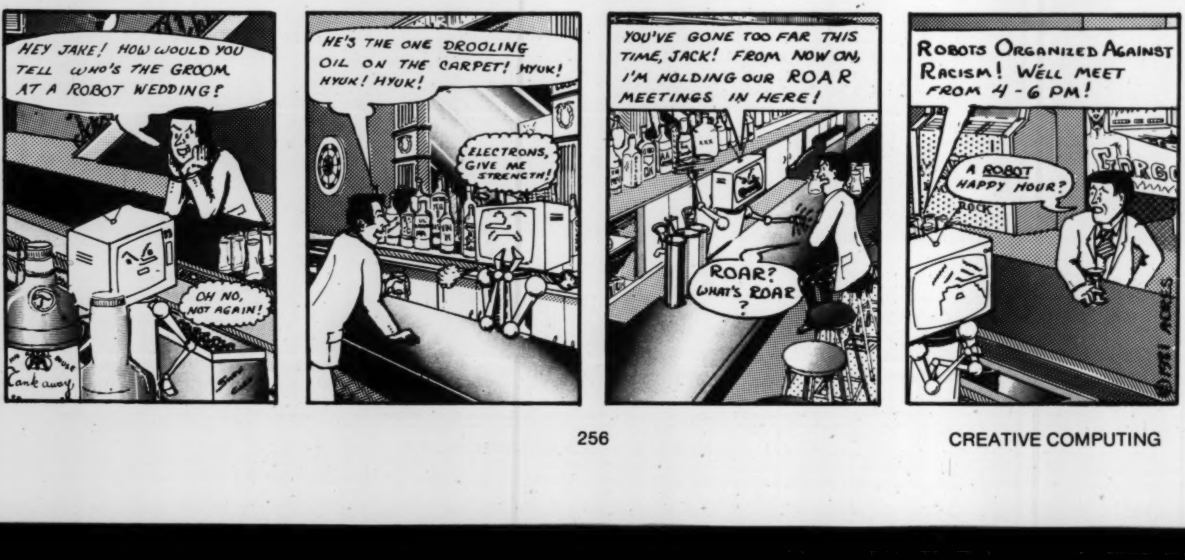
In a more general situation, the program must decide the extent to which a bid conveys information that has not already been conveyed. One way to do this is to count the number of variables which can be updated after making a particular bid. If a bid provides information which gives useful information about three of the variables, then the bid is, in some sense, more useful to the program's partner than a bid which gives useful information about only two variables.

One final point, which is important to implement because of the necessity of playing a contract in the best suit (or in No-Trumps if that is better than a suit contract): throughout the bidding the program should keep some kind of measure for each suit and for No-Trumps. This measure should indicate the desirability of playing a contract in that suit. At the start of the hand, when the cards are dealt, the measures might simply be the number of high card points in each of the suits (excluding the points for singletons and voids). For No-Trumps the measure should be zero. When the program's partner makes a bid, the number of high card points for the suit bid should be increased by (say) 8 for the first time that partner bids the suit, 4 for the second time and 2 for the third time. If the program's partner bids all of the suits in which the program does not have adequate control (either an ace, or a king and one other card, a queen and two other cards or a jack and three other cards), then the number of points assigned to No-Trumps can be adjusted to some high value (say 15). Each time that the partner bids another suit, which he has not yet bid, this score is increased by 2. The program then has a relatively easy measure of whether each suit is worthwhile, and whether No-Trumps is a possibility. Then, as the level of the bidding gets nearer and nearer to the guideline limits, the program can easily make a decision about the final contract. It is then only important to avoid making a bid which is so high that partner can no longer make a safe bid (ie, a bid within the guideline limits) in a suit which is deemed to be acceptable.

Next month, I shall write about playing the hand once the bidding is over. In the meantime, I suggest that you find a good book on bidding and select an easily programmable system. ☐

Bit Pit

Chas Andres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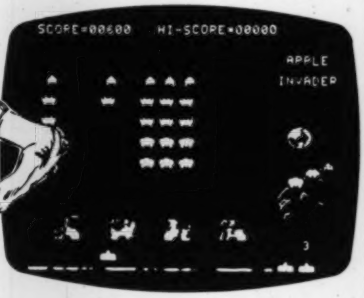
Super Invasion

Disk CS-4508 $29.95
Requires 48K Apple II or Apple II Plus

This original invasion game features superb high resolution graphics, nail biting tension and hilarious antics by the moon creatures. Fifty-five aliens whiz across the screen, quickening their descent, challenging you to come out from behind your blockades and pick them off with your lasers. A self-running "attract mode" makes it easy to learn and demonstrate the game. Game paddles are required.



Gradebook

Disk CS-4709 $24.95 Requires 32K Applesoft or Apple II Plus

The GRADEBOOK system is a package of ten interlocking programs in APPLESOFT BASIC on a single diskette. Gradebook brings the speed and accuracy of the computer to the teacher's traditional grading and record-keeping procedures. In this process, several new capabilities emerge. Some are described below, while you will discover others for yourself as you explore this highly interactive, user-oriented system designed with the classroom teacher in mind.

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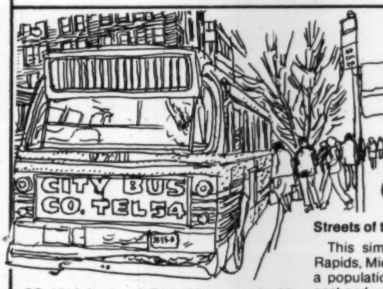

Trucker and Streets of the City

CS 4710 Applesoft Disk (32K) $24.95

Trucker

This program simulates coast-to-coast trips by an independent trucker hauling various cargos. The user may haul oranges, freight or U.S. mail. All have different risks and rewards. Maximum profit comes from prudent risk-taking.

If all goes well, you can obey the speed limits, stop for eight hours of sleep each night and still meet the schedule. Bad weather, road construction or flat tires may put you behind schedule. You may try to increase your profit by skimping on sleep, driving fast or carrying an overweight load.

Other factors are choice of routes, truck payments, fuel, food, tolls and fines. The simulation is engrossing and informative.

Streets of the City

This simulation is modeled on Grand Rapids, Michigan, a metropolitan area with a population of 550,000. The budgeting, cost and work standard bases are derived from actual experiences of the city over the past five years. The objective of the simulation is to complete a ten-year plan of street and transit improvements while retaining the support of a majority of the City Commission.

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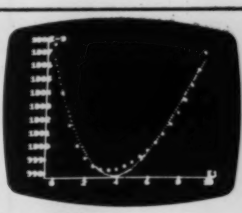
Other factors to be considered are operating tax levies, construction bonding and labor negotiations. The simulation provides a substantial challenge and it is both educational and entertaining.

Scientific Plotter and Curve Fitter



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Disk CS-4803, $24.95
Requires 48K Apple II Plus

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This brief description barely begins to cover the full range of this versatile graphic aid. The program can scale logarithmically, scale each axis independently, plot selectively in quadrants of the screen, plot with any of twenty symbols in four different sizes, and much more. Anyone who needs to convert data into meaningful graphs will find that **Scientific Plotter** is an invaluable aid.

Curve Fitter

Disk CS-4804, $34.95
Requires 48K Apple II Plus

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Disk CS-4802, $24.95 48K Apple II Plus

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Harold L. Novick

The comments and opinions of the author are given for educational purposes only and are not meant to be legal advice. Specific legal questions should be referred to your personal attorney.

...software legal forum...

A funny thing happened on the way to the forum; not the column, but the writer's office. A letter was delivered that discussed a new twist in the attempt to obtain legal protection for computer programs. The program is a video game and the protection attempted was a copyright of a computer video game as evidenced by a videotape of a game being played.

Interesting, to say the least.

Suppose that the computer video game is embodied in a ROM and the intention is to sell an integral computer system. The system includes the ROM, a power supply, a microprocessor and supporting chips, a video monitor, a video board, an operator's control panel, and the interfacing electronics, all housed in a single cabinet. Where would the copyright notice be placed? Suppose further that someone copies only the ROM's and sells only the ROM's. Is there any copyright infringement? What if this is a very popular game and someone else extracts the computer program from the ROM, disassembles the program, changes the program to delete only the trademarked words from the video presentation and adds other titles, and then sells a complete system. Any copyright infringement? What if a third person only observes the game, and writes a similar computer program using a substantially similar video presentation. Now is there any copyright infringement?

The rhetorical questioning isn't over, though. Assume further that the copied game is itself an authorized variation of another well known game. How does one protect the game? If copyright protection is used, where is the notice placed and what "copies" are filed in the Copyright Office? There is a saying among computer people that any computer program can be replaced with hardware and anything in hardware can be replaced with software. If the game is not patentable or can no longer be patented (e.g. it was first sold on a small scale two years ago), how can the game be protected?

The amazing thing about the law is that it is constantly being confronted with unique, exotic problems. The scenario that gave rise to the above questions is presently being acted out in numerous variations. With the exploding proliferation of computer video games, new comers, late comers and counterfeiters are attempting to reap their profits quickly. At this writing (in early June), there are no fewer than 25 or 30 different parties involved in defending numerous legal actions. The above series of questions was derived from an attempt by the United States licensee of the video arcade game Galaxian, the Midway Manufacturing Co. of Franklin Park, IL, to protect its game and stop the importation of numerous variations. Midway claimed a copyright for the game; printed a copyright notice on the glass cover of the video monitor; videotaped a game being played; and filed its application for the registration of the copyright claim together with the video tape for the "entire work" on a form used only for audiovisual works.

Next came ye old "infringers," some of whom allegedly copied the ROMs, made their own integral systems outside the United States, and tried to import the system into the country. Midway, following the example of all good software proprietors, went to court to stop them. More accurately, Midway filed a petition with the International Trade Commission, a governmental agency, to exclude the allegedly pirated systems under the unfair competition clause in the Tariff Act.

Although Midway may have been correct in most cases, in one case it was absolutely wrong. The accused infringer was an independent, but simultaneous developer of a very similar game. It appears that when the Space Invaders game was displayed by Taito at a show in Japan in April, 1979, the video game industry went wild. Universal Company, Ltd. of Japan developed its variation called Cosmic Alien at the same time the Galaxian game was being developed by Namco Ltd. It turned out there these two variations were "substantially similar" to one another. Interesting.

Midway, Namco's licensee, had said that the Cosmic Alien game was an infringement of its Galaxian game because of the following similarities: same background on video display; a plurality of rows of aliens; top two rows of aliens having a different color; a nearly identical overall color pattern; two alien squad leaders; three defenders to shoot missiles; the aliens peel off in groups and the squad leaders peel off; the aliens flap their wings, but the squad leaders do not; similar screen organization, scoring and location of defenders; rows of aliens move back and forth; when two players play, the screen is restored for each player.

As a result of these similarities, Midway accused Universal of unfair trade practices and of copyright infringement. Of course, Midway was wrong. But this does raise the questions of how to tell when there is copyright infringement and of how to protect the first produced computer video game from subsequent variations.

Traditional copyright law does not adequately protect the computer video game. In traditional copyright law, infringement requires a proof of the ownership of a valid copyright and a copying by the infringer. In the Midway case it appears that there are problems in providing both elements. What is copyrighted in a computer video game? The computer program? The visual presentation where the analogy is made to a videotape?

In the present case, Midway decided not to register its copyright claim to the computer program. This columnist was unable to find out its reasons. However, if those reasons included an attempt to keep secret the computer program, they failed.

Harold L. Novick, Patent Attorney, Larson & Taylor, Arlington, VA 22202.

Small Business Computers NEWSLETTER

Small Business Computers Acquired by Creative Computing

Photo courtesy of Alanthus Data Communications Corporation.

August 1, 1981, Morris Plains, NJ—Publisher David H. Ahl announced today that *Small Business Computers* had been acquired by *Creative Computing*. Howard Falk will remain as editor of *Small Business Computers*, however, the rest of the staff will be substantially enlarged. The publication, a bi-monthly, also will be substantially enlarged with both editorial material and advertising.

Ahl, a strong believer in synergy, believes that *Creative Computing* has much to offer to *Small Business Computers*. On the editorial side, *Creative Computing* has a large staff of contributing editors with a wide range of experience in all areas of the computer field. "Indeed, we have not been taking advantage of the business expertise o. our contributing editors," said Ahl, "because *Creative Computing* was just not the right vehicle to run a large number of business-related applications, articles and programs." These articles, applications, and evaluations will now appear in *Small Business Computers*.

One contributing editor, Glenn Hart, is vice-president of a major consumer goods manufacturer and has responsibility for distributing products to super markets, drug stores, and other similar outlets throughout the United States. His sales people use handheld terminals to record and report each day's orders. Mr. Hart has developed a series of computer programs to analyze these data and to pinpoint potential trouble spots in inventory, shipping, and production before they occur. In addition, he has a large group of programs for the TRS-80 pocket computer as well as larger units which aid him in managing all aspects of the business.

Another contributing editor, George Miller, works for a major bank and is responsible for selecting equipment and implementing office automation throughout the hundreds of branches of the bank. Thus, he is concerned not only with the automation of an individual branch, but with the communication of the equipment within the branch and regional centers and to the home office. Mr. Miller wrote a major article on office automation which appeared in the May, 1981 issue of *Creative Computing*.

Other regular contributing editors include the manager of a radio/tv/electronics store, the president of a fish farm, the general manager of a PBS television station, and the director of a major market research company. In addition, scores of other contributors representing all types of businesses will be tapped for *Small Business Computers*.

In addition to editorial expertise, *Creative Computing* also has a long history of editorial integrity, particularly with respect to product evaluations and reviews. "While many magazines don't want to risk offending an advertiser," Ahl said, "we feel that our first obligation is to our readers." Thus *Creative Computing* has a well-deserved reputation in the industry for running hard-hitting, in-depth product evaluations.

For example, *Creative Computing* compared word processing printers and found two losers among highly promoted makes. Of sixteen educational packages, *Creative Computing* found that only seven offered solid learning value.

"On the other hand, occasionally this policy turns up a diamond in the rough," said Ahl. "For example, we found one computer had far more than its advertised capability." While unbiased, objective reviews can occasionally cost an advertiser, usually temporarily, Ahl believes that in the long run editorial integrity pays off both to readers and to advertisers. If the contents of the magazine are honest, the readers keep coming back for more and high loyalty is maintained. In addition, if the reviews and evaluations are eminently believable, this believability carries over to the remaining contents of the magazine including the advertising.

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Legal Forum, continued...

As mentioned above, copying is the other part of the infringement question. On the other hand, if Midway wanted to protect other variations of the game produced by a means other than copying the computer program, then at least that would provide a justification for filing a copyright claim to the visual presentation. This they tried to do by filing a videotape of a game being played as the best edition of the work whose copyright claim was being registered. In fact it seems that this latter approach is the one being adopted by many of the arcade computer video games.

How one can or should protect a video game is not an easy question to answer based on the present advanced state of the technology and the present delayed state of the law. However, the ownership of a copyright in a videotape is not a copyright in the "game." It may or may not be the best edition of the work which must accompany the application. It is the opinion of many that a game cannot be copyrighted; a game can only be patented. A copyright does not extend to the ideas, methods, and concepts, only to their particular expression.

Take the well known board game, Monopoly. The game was patented sometime around 1939. The particular visual image of the board was not patented; it was copyrighted. Only the theory and the play of the game were patented. The instruction set which was a particular way of expressing the play of the game was also copyrighted. In 1939, the patent would have provided protection for only 17 years, but the copyright would have been in effect for a term of 28 years, renewable for one second term of 28 years. (The new law has a single term of 75 years for works for hire or life of the author plus 50 years.) Thus the patent, which provided the better protection, expired first and left only the copyrightable aspects of the game (i.e. the visual expression) protected.

In Midway's Galaxian game, there apparently is no patent; only a copyright notice on the console and a deposited videotape. Obviously Midway does not sell videotapes and presumably could care less if anyone made a copy of the videotape. They want to protect the "game" so that if someone else makes and sells one, they can be stopped.

In order to stop one from infringing a copyright, the law requires that the claim for copyright be registered before the suit is brought. Therefore the question of whether Midway has a valid copyright in the game based on the deposited videotape is not academic. The answer to this question is tied in with the answer to whether the Galaxian copyrighted work was copied. In the Midway case, it is obvious that the alleged infringers did not copy the videotape. They probably never saw the videotape. Furthermore, because in copyright cases it is usually impossible to get a witness to testify as to the actual making of the copy, the circumstantial evidence of substantial similarity and access to the copyrighted work is proven as an alternative.

In the preliminary decision in the Midway action, the Administrative Law Judge hearing the case held that the "games" of 14 of the 24 alleged infringers were substantially similar to Midway's Galaxian "game" and that these fourteen had access to the Galaxian game. If the game were the copyrighted work, there would be no problem. In this case the problem is that there is no practical possibility that any game being played will be identical to the game that was videotaped and filed with the application. The question then becomes, does the videotape of one game offer copyright protection to every other game?

If the video game being played were the game of "Life," then the answer to the above question is probably no. On the other hand, if the videotape were of a constantly repeating and repeatable design (e.g. of a kaleidoscope design), then access to and substantial similarity with the game being played would probably be all that is necessary. The "performance" of the game at any time would always produce the same sequence of video images. Clearly the Galaxian game is somewhere in between. Where the line should be drawn as to when the "game" is effectively protected by a copyright of only the audiovisual performance of one game is a question that has never been asked before let alone ever answered.

It seems that the better course for Midway to have taken would have been to also register their claim to the computer program. They did not choose to do so, and therefore if they lose the present round because they dropped into a crack in the present law, they have only themselves to blame. ☐

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CIRCLE 174 ON READER SERVICE CARD

ns...puzzles & problems...pu

It's time to acknowledge some of the "better" solutions that Merlin receives to the "change-the-word" puzzles he presents from time to time. The first is overdue recognition to Mr. James Fletcher Muir of Pleasanton, California, for his solution to the "PLAY" to "WORK" puzzle that appeared in the July, 1980 issue. "PLAY, FLAY, FLAM, FOAM, FORM, FORK, WORK". Mr. Muir's solution was two less moves than our answer. Great puzzling! The following readers came up with the following solution to the "APE" to "MAN" problem in the January, 1981 issue; "APE, APT, OPT, OAT, MAT, MAN". They are: Barbara Burse-Hanning; Gary Solomon, Lake Success, N.Y.; Paul A. Kirschner, Groningen, The Netherlands; Victor G. Feser, Bismarck, N.D.; Richard F. Silloway, Mt. Pleasant, S.C.; Finally, in the May, 1981 issue we presented "LEAD" to "GOLD" giving an answer in four moves. The following solution, "LEAD, LOAD, GOAD, GOLD", was sent in by; Christopher K. Johansen, Hot Springs, N.C.; Bruce Bowler, Schenectady, N.Y.; Bill Foster, Nutley, N.J.; Larry L. Taylor, Tulsa, Oklahoma; George Kramer, Danbury, Ct.; Virginia L. Thorndike, Orford, N.H.; Edward Wellen, New Rochelle, N.Y.; Willard Hall, Washington, N.C.; Edward Scher, N.Y., N.Y.: Dr. Morris Bader, Bethlehem, Pa.; Robert Huls, Normal, Ill.; Royland Pettersen, Las Vegas, Nev.; Albert Waltner, Portland, Or.; and Neil Rest, Chicago, Ill. Thank you for taking the time to write. Your answers were great.

D	E	A	L
S	H	O	T

A Wild West Problem

Here's a new "change-the-word" puzzle to start the letters coming in again. In the old American West, if a card player was caught in an attempt to tilt the odds of poker in his favor during his DEAL with the pasteboards, it often came to pass that he would end up being SHOT or run out of town on a rail. Our first puzzle gives you the opportunity to solve the problem of changing DEAL to SHOT without getting caught along the way. (During each step the puzzler must change one letter in the previous word so that a new word is formed.) (This puzzle is from *Merlin's Puzzler 2* by Charles Barry Townsend, and published by Hammond, Inc.)

A Money Problem

The following "Golden Oldie" was sent in by Mr. George Kramer of Danbury, Ct. Merlin will be sending him something better than money, namely a copy of one of his famous books. Mr. Kramer writes; "an impoverished college student sent the telegram pictured here to his father. The son was so short of cash that he could not include the sum he needed in the telegram so the father had to figure it out himself. Each letter of the message represents a digit (zero through nine). How much, in dollars and cents, does the son need?"

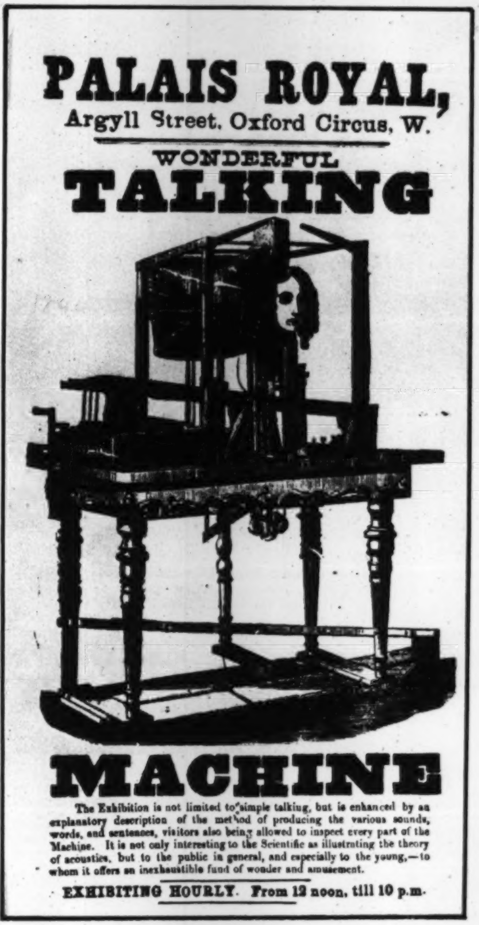
```
  SEND
 +MORE
 -----
 MONEY
```

Which is Which?

From Sweden comes this interesting test in detection. Our thanks go out to Mr. Peter Fagerberg of Stockholm, Sweden. A copy of *Merlin's Puzzler* is winging your way.

"I hereby send you a puzzle that I find both interesting and challenging. The puzzle is about 3 men who all work in a bank. In their spare time they all have 2 hobbies. They are: truckdriver, smuggler, trumpeter, golfplayer, computer technician and barber. Given some clues one is to find out the 3 mens' hobbies. Their names are John, Dick and Roger.

Here are some clues:
1. The truckdriver flirted with the golfplayer's sister.
2. The trumpeter and the computer technician used to go horseback riding with John.
3. The truckdriver laughed at the trumpeter because of his long beard.
4. Dick received a box of chocolate from the computer technician.
5. The golfplayer bought a used car from the smuggler.
6. Roger was faster than both Dick and the golfplayer at eating pizza.



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How many men, how many women, and how many children will be required to fill the theater with 100 people paying a total of $100.00?

Mr. J. A. Faudale, of Springfield, Virginia, sent us this puzzle. Merlin is sending Mr. Faudale a copy of *Merlin's Puzzler 3,* a happy trade indeed.

Dog's Mead

Put on your thinking caps, puzzlers, a real challenge has been hurled at you by Mr. William F. Meldrum of Belleville, Illinois. He writes that he came across this puzzle about 20 years ago but can't recall where. Merlin loves the name of the puzzle and is sending Mr. Meldrum a copy of *Merlin's Puzzler.* The puzzle goes like this:

"A famous old English puzzle is called Dog's Mead. Although it relates to a farmer, his family, and his land, it involves a good deal of engineering math and logic. The problem is to find the age of Mrs. Groosby, Farmer Dunk's mother-in-law. And you must *not* assume the puzzle was invented this year."

"You'll need to know that there are 20 English shillings to the pound sterling, that an acre is 4840 square yards, and that a rood is a quarter of an acre. Also these hints help: One number in the puzzle is the area of Dog's Mead in roods, but it relates to something in the puzzle quite different from that area. One of the numbers across is the same as one of the numbers down. So, here you are. (THERE ARE NO FRACTIONS INVOLVED; ALL ANSWERS ARE IN WHOLE, SIGNIFICANT NUMBERS; NO PRECEDING ZEROS.)"

ACROSS

1. Area of Dog's Mead in square yards.
5. Age of Farmer Dunk's daughter, Martha.
6. The difference between the length and breadth of Dog's Mead in yards.
7. Number of roods in Dog's Mead times number nine down.
8. The year when Little Piggly came into occupation by the Dunk family.
10. Farmer Dunk's age.
11. The year when Farmer Dunk's youngest child, Mary, was born.
14. Perimeter of Dog's Mead in yards.
15. The cube of Farmer Dunk's walking speed in miles per hour.
16. Number fifteen across minus number nine down.

DOWN

1. The value of Dog's Mead in shillings per acre.
2. The square of Mrs. Groosby's age.
3. The age of Mary.
4. The value of Dog's Mead in pounds sterling.
6. The age of Farmer Dunk's first-born, Edward, who will be twice as old as Mary next year.
7. The square, in yards, of the breadth of Dog's Mead.
8. The number of minutes Farmer Dunk needs to walk one and one-third times around Dog's Mead.
9. Ten across times nine down.
12. One more than the sum of the digits in the second column down.
13. Length of tenure, in years, of Little Piggly by the Dunk family.

1		2	3		▨	4
	▨	5		▨	6	
	▨		▨	7		
▨	8		9		▨	▨
10		▨	11		12	13
	▨	▨	▨	14		
15		▨	16		▨	

A Roman Problem

Our last puzzle is from Mr. Jonathan Greenfield of Nahaiya, Israel. Mr. Greenfield will receive one of Merlin's books for his contribution.

"The following puzzle represents a math problem using Roman numerals. Below is a mathematical expression which is not true. Can you shift one stick around so that the expression becomes true?"

$$\frac{XIX}{VIII} = II$$

Answers on page 288.

That's it for this month, folks. Remember, if you have any puzzles that you would like to see printed in this column send them along to Merlin. If he uses your puzzle he will send you one of his famous books. So long until next month.

Your editor,

Charles Barry Townsend

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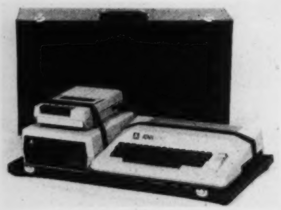

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eviews...book r

Steve Gray, et al.

Business Programming in Fortran IV and ANSI Fortran 77: A Structured Approach, by Asad Khailany. Prentice-Hall, Inc., Englewood Cliffs, NJ. 456 pages, paperback $13.95. 1981.

This book is "primarily designed for students in business schools taking an introductory programming course in the Fortran language . . . The text orientation also makes it appropriate for students in humanities, social science, and education," according to the preface.

The author claims his textbook is different from "others in the field" because it combines a data-processing textbook and a Fortran textbook, covers both Fortran IV and ANSI Fortran 77, gives extensive examples and exercises, emphasizes structured programming, etc. Last on the list of features is, "All programs are stored on the DECSYSTEM-10. Inquire about them from the author to get all programs on a DEC tape."

The first chapter discusses computers (hardware, software, industry, careers), the second, problem-solving tools (algorithms, pseudocode, flowcharts). The remaining 14 chapters are on Fortran. Three appendixes cover number systems and provide summaries of the two Fortrans.

Almost all programming examples are of business programs. The first algorithm in the chapter on tools is for a car rental problem; the second, on stock transaction service charges. Others in later chapters are on sales forecasting, payroll, sales commissions, etc.

A separate instruction manual contains the solutions and programs for all exercises in the text, plus samples of exams and course syllabi.

None of the programs is very long; the author is more interested in providing a solid grounding in the principles of Fortran, and continually improves on the payroll program, among others, as new statements are introduced. Throughout the book, the differences between the two Fortrans are explained in detail.

The Computer in the School: Tutor, Tool, Tutee, edited by Robert P. Taylor. Teacher's College Press, Teacher's College, Columbia University, New York. 282 pages, paperback $14.95. 1980.

This book is meant to help educators and parents who are "beginning to seriously ponder what the role of computing will be in human learning and what action they can and should take to affect it," according to the introduction to 19 essays by "five pioneers in the field of computers in education": Alfred Bork, Thomas Dwyer, Arthur Luehrmann, Seymour Papert, and Patrick Suppert.

The essays cover a wide area of teaching and learning, intended "to build a good foundation for understanding the basic issues involved in using computers of any kind in schools, the teacher's role in helping the student to make full use of computing, and the general limitations of computer use," as the back cover puts it.

The essays are on subjects such as Preparing Student-Computer Dialogs (Bork), Learning through Graphics (Bork), Some thoughts on Computers and Greatness in Teaching (Dwyer), The Fundamental Problem of Computer-Enhanced Education and Some Ideas about a Solution (Dwyer), Should the Computer Teach the Student, or Vice-Versa? (Luehrmann), Technology in Science Education (Luehrmann), Teaching Children Thinking (Papert), Personal Computing and Its Impact on Education (Papert), Computer-based Mathematics Instruction (Suppert), The Future of Computers in Education (Suppert).

Most of the essays are quite helpful, presenting useful examples, cogent thoughts, and useful references. Some of the writing touts a writer's pet theory, or flails his special *bête noire*, but fortunately there isn't much of this, in a book whose ultimate purpose is apparently to show parents, teachers, school boards and administrators why computers should be used in every classroom.

Microprogrammed Control and Reliable Design of Small Computers, by George D. Kraft and Wing N. Toy. Prentice-Hall Inc., Englewood Cliffs, NJ. 443 pages, hardcover $21.95. 1981.

Page iv carries a 1981 copyright by Bell Telephone Laboratories, which seems odd until you find that the system selected to provide examples of modern microprogramming is the Bell System 3A CC, a small computer designed to control the No. 3 ESS, or Electronic Switching System, which can handle from 500 to 5,000 telephone lines.

No knowledge of telephony is required to understand this book, "written as a reference volume for the practicing electrical engineer or computer scientist who has a need to develop a fault-tolerant small computer. The book could be used as a reference text in a college course taught at the junior, senior, or first-year graduate level," according to the preface.

The word "telephone" isn't even in the index of this book, whose nine chapters discuss Conventional and Microprogram Control, Internal Process Control, Microprogram Control of Main Storage Operations, Microprogram Control of Input/Output Operations, Reliability Calculations, Maintenance Design Considerations, Fault Detection, Fault Diagnosis, and Fault-Tolerant Design of ESS Processors. A brief appendix describes MTTF Calculation of Systems with Repair, using integral equations, a knowledge of which is also needed to understand the chapter on reliability calculations. The other chapters use no more than Boolean algebra, and very little of that.

This book is an expansion of the 1979 Kraft-Toy book for Prentice-Hall on Mini/Microcomputer Hardware Design. It presents in detail the design philosophies and approaches used by Bell Labs to implement the 3A CC, "a small computer designed to observe the high reliability requirements of the Bell System (i.e., two hours downtime in 40 years of operation.)"

The Small Computer in Small Business: A Guide to Selection and Use, by Brian R. Smith. Stephen Greene Press, Box 1000, Brattleboro, VT 05301. 154 pages, hardcover $12.50. 1981.

"Smith's book is geared toward the small-business manager who needs a primer in order to be able to deal intelligently with computer vendors," according to the letter accompanying this book.

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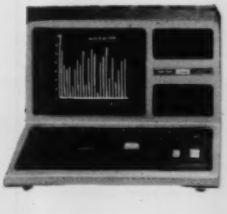

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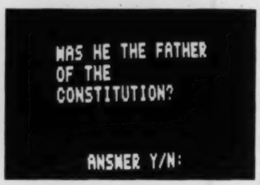

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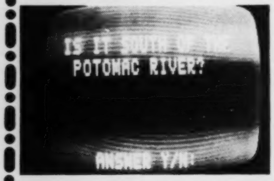

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Small Business, Applications, Justifying a Computer for Your Business, Evaluating and Selecting a Computer System, Planning for the Computer, and Final Thoughts (alternatives to the computer, used equipment, documentation, etc.).

Four appendixes cover The Future of Small Business Computing (EFT, databases, credit, etc.), A Notepad for Computer Evaluation, Bibliography, and Glossary.

Although the first two chapters aren't very well organized, and present more information in the nuts-and-bolts area than many readers would care about, the remaining chapters are better, and present much information of interest to the manager. If at times some paragraphs seem skimpy, perhaps it's because the author didn't want to get too far into the many byways that present themselves in such a book.

The meat of the book is the four chapters on software, applications, justifying a computer, and evaluation. The first looks at operating sytems, compilers, and languages such as Fortran, Basic, Cobol, etc. The second examines a payroll system, turnkey software, general ledger, A/P, A/R, inventory control, word processing, etc. The third gets into financial analysis and cost savings, while the fourth provides several dozen questions to ask.

A Primer on Structured Program Design, by Gary L. Richardson, Charles W. Butler, and John D. Tomlinson. Petrocelli Books Inc., Princeton, NJ. 241 pages, hardcover $17.50, paperback $14. 1980.

Written as part of the PBI Series for the Computer and Data Processing Professional, this book was written for the student learning about programming, or for "one who already knows the mechanics of a computer language and is now concerned about the design process," according to the preface.

Because PL/1 was found to "best fit the spirit" of structured design, it is used throughout as the illustrative language.

Structured programming means, among other things, eliminating GOTOs and instead using the coding structures of SEQUENCE, IFTHENELSE, DOWHILE, DOUNTIL, and CASE (multibranch); top-down design; pseudo-code; or the chief-programmer team-management process.

The book's ten chapters cover Background, Evolution of Program Design Methodologies, Top-Down Design, Structured Programming, Structured Design Techniques, Pseudo-Coding, Program Style and Debugging, Data Base Considerations, Managing the Programming Process, and Final Remarks. Each chapter ends with review questions and references.

The book ends with an appendix with the solution to a debugging case-study of a biorhythm program, and a glossary.

Although the writing style is formal and somewhat stiff, with phrases such as "This chapter has attempted to address some of the more pragmatic issues," the text is very helpful, and the many figures and programming examples also help turn the art of system design into a science.

Personal Computers Serving People: A Guide to Human Service Applications. by Robert A. Lavine. Hawkins & Associates Inc. 804 D St. N.E.. Washington. DC 20002. 149 pages. paperback $7.95. 1980.

According to the introductory chapter. this book "is intended as an introductory guide for the person who may have little or no background in computing and who would like to begin using a personal computer in such activities as teaching, special education, rehabilitation, recreation and leisure, and creative art."

The other seven chapters cover: the essentials of Basic and computer hardware, Education with Personal Computers (5 programs: multiplication practice, reaction time, grade distribution, etc.), Education and Rehabilitation for the Handicapped (2 programs: phrase builder, word-comparision game), Creative Art (2 programs: city skyline, color graphics), recreation and leisure (3 programs: number-guess, ball-and-paddle, round-robin tournament), selecting a computer (Apple II, Radio Shack TRS-80, Commodore PET, etc.), Sources of Information and Inspiration (books, magazines).

The two chapters on education, covering 58 pages, are the heart of this book, and present a good variety of examples. However, most of the programs presented in these two chapters wouldn't be understood by the readers for whom the book is supposed to be intended. They use POKE, LEN, DIM, etc., none of which are even mentioned in the chapter on Basic. On the other hand, the programs are explained at length, so the reader who really digs in, may get some idea of how they work.

The other chapters are less than noteworthy, and have been written better elsewhere. However, the author must be given an A for effort, in trying to put together a variety of information that, to be adequately covered, would take three times as many pages.

Programming with Fortran/WATFOR/WATFIV, by David T. Basso and Ronald D. Schwartz. Winthrop Publishers Inc., Cambridge, MA. 415 pages, paperback $12.95. 1981.

This is the two-dozenth book in the Winthrop Computer Systems Series, which includes works on Basic, keyed input, and software psychology. As a primary sourcebook, this text "requires no knowledge of computing. The text can best be used with an IBM 360, 370, 303X or 4300 series computer system (or PCM) with the full OS operating system" according to the back cover.

WATFOR/FIV are the University of Waterloo (Canada) versions of Fortran IV, and in most respects identical to Fortran IV. Among the significant features incorporated into WATFOR/FIV are the error messages generated when a programming error is encountered.

The ten chapters cover Introduction to Computer Problem Solving, Elements of WATFOR/FIV, WATFOR/FIV Arithmetic Operations, Format-free Input/Output, Control Statements, Looping and the DO Statement, Arrays and Subscripted Variables, Subprograms and Subroutines, and Additional Language Features and Techniques. Exercises, with spaces to fill in the answers, are provided within and at the end of chapters.

Six appendixes provide additional review exercises, information about formatted input/output, supplementary programming assignments, WATFOR and WATFIV diagnostic messages, and answers to selected exercises.

The writing style is semi-conversational and somewhat stiffly formal, but the authors have done their best to provide a slow start, gradual buildup, short and simple programs, thorough explanations of programs, and a fair amount of detail.

The book has been made very easy to read, with extra spacing between the lines, and all programs set in large sans-serif type.

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Introduction to Computer Operations, by William M. Fuori, Anthony D'Arco and Lawrence Orilia. Prentice-Hall, Inc., Englewood Cliffs, NJ. 638 pages, hardcover $19. Second edition, 1981.

"This text will give students a basic understanding of what a computer is, what it can do, and what equipment is generally found in a medium- or large-scale computer complex," the preface says.

The book concentrates on hardware, with chapters on punched cards, I/O devices (card reader/punch, printer, mag tape, disks and drums, and terminals), computer systems (number systems, system components, languages), consoles. The longest chapter is on The Console and Console Typewriter, 172 pages on the console, console operations, mini- and microcomputer systems, scheduling and documentation, and data-center operations.

Self-study exercises are scattered throughout the text, with answers supplied. Extensive end-of-chapter exercises are followed immediately by the answers.

Three appendixes provide a glossary, unit record machine operational concepts, and DP job titles and description. The authors have used a great many photographs, drawings and charts.

The writing, although semi-formal, is very clear and detailed, explaining the many complex operations and concepts about as simply as possible.

This second edition apparently updates the portions that get out of date rapidly, mainly on terminals and mini- and microcomputers.

Aside from its usefulness in the classroom, this is also a fine book for anyone wanting to know exactly what goes on, and how, in the computer centers.

Computer Systems Performance Modeling, by Charles H. Sauer and K. Mani Chandy. Prentice-Hall Inc., Englewood Cliffs, NJ. 364 pages, hardcover $18.95. 1981.

The audience for this book is divided between college seniors and first-year graduate students taking an introductory course in performance modeling and as supplementary reading for graduate systems courses, and designers, developers and others to help them achieve optimum system effectiveness at the lowest lifetime cost, accoring to the preface and back cover.

The back cover continues, "An attractive alternative to after-the-fact modifications is the mathematical model that estimates performance early in the design and development stages and permits appropriate adjustments for the system becomes operational."

The volume introduces the key concepts of modeling, their practical application, and their management. Detailed chapters cover general principles, Markovian queuing models of computer systems, isolated queues and open networks of queues, closed product form queuing networks, approximation, simulation, measurement and parameter estimation, case studies, and management modeling projects.

"It is common, but unfortunate," the authors point out, "that performance is not seriously considered until the later stages of system evolution" when remedies, such as the acquisition of additional hardware, can be costly.

This book requires familiarity with elementary calculus and linear algebra, and a thorough understanding of computing systems and programming.

Imagineering—How to Profit From Your Creative Powers by Michael LeBoeuf. McGraw-Hill, New York, NY. 1980.

"The real purpose of books is to trap the mind into doing its own thinking." This quote by Christopher Morley, found in both *Creative Computing* and *Imagineering*, gives a clue to the contents of this readable volume.

The definition of imagineering is "letting your imagination soar and then engineering it down to earth." The author provides us with many "valuable, practical techniques...for generating ideas and turning them into successful realities." These statements from the introduction provide a starting point for readers who want to develop their abilities of creative thinking and action.

This work is well-organized. It contains twelve chapters and an introduction that explains the major topics of each chapter. The overall organization consists of four major subdivisions: Redesigning Your Imagination Foundation; Generating and Processing Ideas; Clearing the Hurdles Between Imagination and Reality; and Following Through to Successful Reality.

Within these subdivisions are presented techniques for realizing our creative potential, releasing that potential through deliberate action and transforming our visualizations into reality. As with most self-help books, this one does not claim to be able to give the reader more creative potential. It does claim to be a tool for harnessing the creative potential in all of us.

LeBoeuf sums up the main concepts of his book in short sections which are handy references. The secret of making dreams come true is contained in the words Curiosity, Confidence, Courage and Constancy. Showing the reader how to develop these traits is done in a readable style. As a final gesture of encouragement, LeBoeuf hopes that "the flow be with you."

I agree that Imagineering presents many valuable techniques for more creative, exciting living. The open-minded individual will consider this an inspirational and useful book.—*Paul Swetik* ☐

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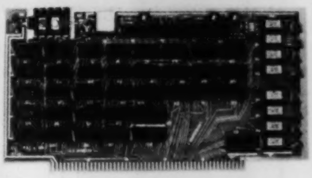

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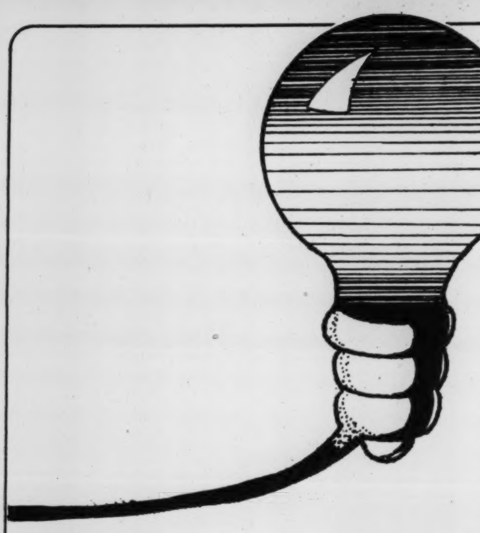

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Commodore **Comal** for PET/CBM computers is being distributed by the Comal Users Group. For more information, send a large SASE ($0.35) to Comal User's Group, 5501 Groveland Ter., Madison, WI 53716.

Micro-DSS/Finance is a financial modeling and planning language for the 48K Apple disk system with Pascal. It is designed to provide managers who are not computer specialists with a "private computer workshop" environment that enables them to experiment, manipulate data, redesign reports and construct presentations. $1500. Addison-Wesley Publishing Co., Inc., Reading, MA 01867.

CIRCLE 351 ON READER SERVICE CARD

Aurora Software Associates announces **S-Forth** for Ohio Scientific computers. S-Forth is a full implementation of fig-Forth, and includes editor, virtual memory disk sub-system, and compatibility with OS65D. The language comes on 5 1/4" or 8" disk. $34.95. Aurora Software Associates, P.O. Box 99553, Cleveland, OH 44199.

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Forth-79 is available on disk for the Apple. The package comes with a screen editor, macroassembler and vocabularies for strings, double precision integers and lo-res graphics. $89.95. MicroMotion, 12077 Wilshire Blvd., #506, Los Angeles, CA 90025. (213) 821-4340.

CIRCLE 353 ON READER SERVICE CARD

SYSTEMS

Nautilus Systems has introduced a **cross-compiler** program for the Forth language. It is available for TRS-80 Model I, H-89, Northstar and CP/M systems. $200. Nautilus Systems, P.O. Box 1098, Santa Cruz, CA 95061. (408) 475-7461.

CIRCLE 354 ON READER SERVICE CARD

Intex Datalog announces a **PC-Basic Compiler** for the Commodore CBM line of computers. Written in machine code, the compiler takes a program which has been saved on disk normally and compiles it back on to the disk as a directly loadable program file. About $600. Intex Datalog Ltd., Eaglescliffe, Stockton-on-Tees, Cleveland TS16 OPN, England.

The **FBasic** compiler runs under the OS65D3 operating system and produces standalone 6502 machine code modules. Features include user definable array locations, WHILE loops, GOTOs and GOSUBs to absolute addresses, and direct access to registers. It requires 48K of memory and is available on 8" disks. $155. Pegasus Software, P.O. Box 100414, Honolulu, HI 96816.

CIRCLE 355 ON READER SERVICE CARD

A Basic compiler designed for 8080 or Z-80 based systems has been introduced on 8" disk by Compiler Systems. **CB80** is a native code compiler which runs under CP/M, MP/M and CP/NET. It retains the 14-digit BCD arithmetic, random and sequential disk accessing and WHILE statement of CBasic and offers improvements in speed and performance. $500. Compiler Systems, Inc., 37 No. Auburn Ave., P.O. Box 145, Sierra Madre, CA 91024. (213) 355-4211.

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Filemanager 800 is a file-keeping system for the Atari 800. It may be used to create mailing lists, inventory and business records, and customer lists. It requires 40K and a disk drive. $94.50. Synapse Software, 820 Conventry Rd., Kensington, CA 94707. (800) 227-1617 ext. 597; in California, (800) 722-3545 ext. 597.

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Crush, Crumble and Chomp allows the player to assume the role of his favorite monster in over 100 possible scenarios. As any of six man-eating beasts, the player must satisfy his enormous appetite by eating his opponents while battling National Guard tanks, infantry, helicopters and a team of mad scientists. The game is available on disk for 48K Apple with Applesoft in ROM and 32K TRS-80 or on cassette for 16K Level II TRS-80 and 32K Atari. $29.95. Also available is the **Dragon's Eye**, a fantasy game in which the player has 21 days to find the Dragon's Eye. While searching, he sees a detailed map of the provinces on the screen along with his location, strength, health and other information. The game is available on cassette for 32K PET and on disk for 48K Apple with Applesoft in ROM. $24.95. Automated Simulations, P.O. Box 4247, Mountain View, CA 94040.

CIRCLE 359 ON READER SERVICE CARD

Empire of the Overmind is a fantasy game from Avalon Hill. The game/puzzle comes with a poem that contains the clues necessary to complete a hero's journey. It is available for TRS-80, Apple and Atari 800. Cassette, $30; disk, $35. Also available from Avalon Hill is **Tanktics** a wargame which comes with a full color mapboard and counters depicting 15 different armored vehicles of the German and Russian armies. It is available on cassette for 24K Atari 400 and 800, 16K Apple, 16K PET, and 16K Level II TRS-80 for $24; and on disk for 32K TRS-80, 32K Apple and 40K Atari 800 for $29. The Avalon Hill Game Company, 4517 Hartford Rd., Baltimore, MD 21214. (301) 254-5300.

CIRCLE 360 ON READER SERVICE CARD

Dungeon Campaign is an Adventure program for the Atari 400 and 800 in which players explore a dungeon in search of gold. Movements are controlled by keyboard or joystick. Each package includes both 8K and 16K versions on cassette. $24.95. Also available are four **games packs** for TRS-80 Model III. Included are such games as Wall Street Challenge, Metropolis, Wildcatting and Space Ace. Each package contains two or four 16K programs. $19.95. Image Computer Products, 615 Academy Dr., Northbrook, IL 60062. (312) 564-5060.

CIRCLE 361 ON READER SERVICE CARD

Riverbank Software announces **International Gran Prix**, a 3-D car race simulation by the author of Three Mile Island. The game features five race courses and eight levels of difficulty. It is available for the 48K Apple II or Apple II Plus with disk and paddle. $30. Riverbank Software Inc., Smith's Landing Rd., P.O. Box 128, Denton, MD 21629. (301) 479-1312.

CIRCLE 362 ON READER SERVICE CARD

CE Software announces **SwordThrust**, a fantasy, role-playing system for the Apple in which players attempt to survive different quests. The experience and treasure acquired in one adventure help in others. CE Software, 801 73rd St., Des Moines, IA 50312. (515) 224-1992.

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Country Carnival is a shooting gallery game with multi-color hi-res animation and real-time carnival sound effects. Available on disk for 48K Apple II and Apple II Plus, the game features an ammunition-eating duck and target rabbits that multiply faster and faster as the game progresses. $24.95. Programma International, Inc., 2908 North Naomi St., Burbank, CA 91504. (213) 594-0240.

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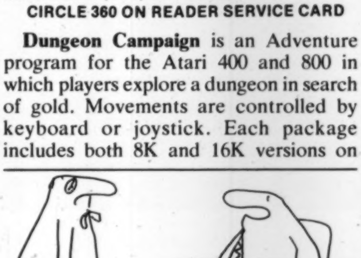

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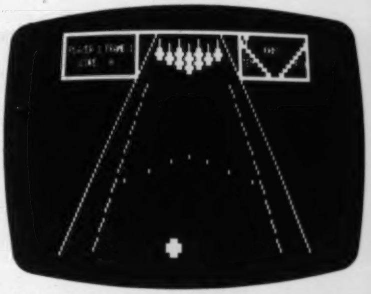
New Products, continued...

Color Invaders for the 16K TRS-80 Color Computer places the player at the controls of a space tank firing at stellar ships and invading critters. Invading ships burst in the air, and alien creatures march across the screen dropping bombs. The game comes in two versions, one which requires the power pack ($19.95) and one which does not ($24.95). Computerware, Box 668, 1512 Encinitas Blvd., Encinitas, CA 92024. (714) 436-0282.

CIRCLE 365 ON READER SERVICE CARD

Acorn Software has introduced **Tenpins**, a machine language bowling game for one to four players on TRS-80 Model I or III. Scoring, pinsetting and ball return are automatic, and players can view the scoresheet at any time. Cassette, $14.95; disk, $20.95. Acorn has also released the following games for the Model III: Pinball, Duel-n-Droids, Everest Explorer, Invaders from Space, Gammon Challenger 2.0, Pigskin, Basketball, Space War, Quad, and Word Wars. Acorn Software Products, Inc., 634 North Carolina Ave., S.E., Washington, DC 20003. (202) 544-4259.

CIRCLE 366 ON READER SERVICE CARD



©CREATIVE COMPUTING

"Dear Diary: I feel that more and more my life is being influenced by computers..."

EDUCATIONAL

Educational Courseware offers a library of disks in 3.2 or 3.3 DOS for use on the Apple. Each menu-driven disk includes a series of programs designed to aid the teacher in the creation and implementation of lessons, which may be altered, modified, stored, or deleted without programming skills. Prices range from $24 to $32. Educational Courseware, 3 Nappa Lane, Westport, CT 06880.

CIRCLE 367 ON READER SERVICE CARD

Spelling Bee, designed for use in kindergarten through third grade, has three objectives: develop computer literacy, establish new vocabulary by linking words with pictures, and build basic spelling skills. The program requires a 48K Apple with Applesoft and DOS 3.3. $29.95. **Compu-Read** 3.0 previously available only in Applesoft, is now available for the 48K Atari with disk drive. It contains a series of instructional modules which build skills by strengthening perceptual processes. $29.95. Edu-Ware Services, 22222 Sherman Way, Ste. 203, Canoga Park, CA 91303. (213) 346-6783.

CIRCLE 368 ON READER SERVICE CARD

BUSINESS

Broker I for the Apple II provides registered representatives with access to customer account information. It allows users to enter current market prices and obtain a value for the client portfolio, and includes a tickler function which displays messages and rewrites on specified

The ultimate APPLE® copy program*

COPY II PLUS

$39⁹⁵

VERSATILE — Copy II Plus copies mulitiple formats — DOS 3.2, 3.3, PASCAL, FORTRAN and CP/M.
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CIRCLE 118 ON READER SERVICE CARD

New Products, continued...

dates. The Telesphere Corporation, 1605 John St., Fort Lee, NJ 07024. (201) 886-2476.

CIRCLE 369 ON READER SERVICE CARD

Mail List Manager for the Apple III is a disk-based program which allows users to store, sort, edit and print mailing labels and phone lists either in their entirety or selectively by zip code, name or other identifying data. The program requires a 128K Apple III and an additional disk drive. $150. Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95014.

CIRCLE 370 ON READER SERVICE CARD

Orders, written in Basic for the TRS-80 Model II, is an integrated invoicing-inventory-accounts receivable system which runs under TRSDOS. The program produces invoices, inventory up-dates, price lists, inventory lists, re-order reports, customer sales histories, open items accounts receivable reports, open items aging, closed items listing, monthly statements and customer listings. $275. National Software Marketing, Inc., Box 6195, Hollywood, FL 33021.

CIRCLE 371 ON READER SERVICE CARD

Databook II from Organic Software maintains a record of appointments for up to 27 people in nine groups of three, for an unlimited time in the future. Written in Pascal, the program runs under CP/M and CP/M 86 as well as UCSD Pascal systems. $295. Organic Software, 1492 Windsor Way, Livermore, CA 94550.

CIRCLE 372 ON READER SERVICE CARD

Broderbund Software announces a **payroll** program for the Apple II which has a capacity of 300 employees, 15 divisions and 30 types of deductions. Tax formulas are built-in, and the program prints checks, check register, W-2 forms and all quarterly and summary reports. It uses Apple's Run Time Module and requires two disk drives. $395. Broderbund Software, Box 3266, Eugene, OR 97405. (503) 343-9024.

CIRCLE 373 ON READER SERVICE CARD

Taranto & Associates announces a **Sales Analysis** enhancement for its Accounts Receivable/Invoicing System for the TRS-80 Model II. The program keeps track of sales by product category and seller for month-to-date and year-to-date. Also available is a **Budgeting** facility which can be added to the company's General Ledger System. Taranto & Associates, Inc., 121 Paul Dr., P.O. Box 6216, San Rafael, CA 94903. (800) 227-2868; in California, (415) 472-2670.

CIRCLE 374 ON READER SERVICE CARD

An **Inventory-Purchasing** module has been added to the Apple Accounting Plus II software package from Systems Plus. The module supports 1000 inventory items per volume and provides details concerning on-hand quantities as well as standard reports. Systems Plus, 3975 East Bayshore, Palo Alto, CA 94303. (415) 969-7047.

CIRCLE 375 ON READER SERVICE CARD

Electric Spreadsheet is designed to be used as a general-purpose tool to prepare tables of data or spreadsheets. Pre-programmed operators are used to accomplish calculations on lines, columns, cells of the sheet, and variable formatting of data and labels of columns and lines is available. Three versions are available: tape for 16K TRS-80 Model I or III ($34.95), tape for 32/48K Model I or III ($64.95), and disk for 48K Model III ($67.95). Dan B. Haney & Associates, Inc., P.O. Box 687, San Mateo, CA 94401.

CIRCLE 376 ON READER SERVICE CARD

Project Management, designed for the project manager on construction, engineering or publicly funded projects, allows the development or analysis of bids; preparation and updating of budget information; entry, updating and tabulation of

Attention TRS-80 Mod II owners: P&T CP/M® 2 has more to offer!

More Disk Storage 596K bytes with double density on standard single sided disk drives. It that's not enough, versions are available for double sided expansion drives (1.2M bytes per disk) and the Cameo Hard disk system (10M bytes.)

More CRT Functions P&T CP/M 2 has the most advanced screen driver available for the Mod II including: erase to end of line/screen, insert/delete line, cursor addressing, non-scrolling area on screen, and much more.

More Serial I/O Capabilities The serial drivers in P&T CP/M 2 support ETX/ACK, XON/XOFF, and request to send handshaking. Direct control of serial ports is also available for special applications.

More Documentation We provide the standard CP/M manuals and our own 150 page manual written specifically for P&T CP/M 2.

More Utilities We have added 14 of our own utility programs for the Mod II to the standard CP/M utilities.

More Useful System Functions P&T CP/M 2 has all sorts of useful features you won't find elsewhere: type-ahead buffer for keyboard input, system time of day clock, automatic program execution and lots more.

Prices

Standard P&T CP/M 2	$185
P&T CP/M 2 for Shugart 850 2 sided drives	$220
P&T CP/M 2 for Cameo Hard Disk system	$250

We also carry other software packages, single & double sided expansion drives and the Cameo Hard Disk System. Write for details.

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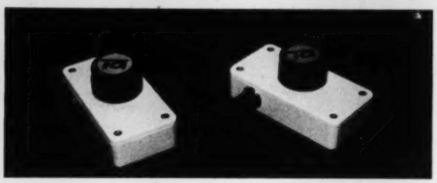
CIRCLE 294 ON READER SERVICE CARD

Super Paddle



Are the paddle controllers on your Apple wearing out? Or did you get a new Apple without paddles?

We've got good news for you! Super Paddles. Each paddle control consists of a high-precision linear potentiometer and a big (1/2" D) industrial-quality pushbutton mounted in a sturdy 4" x 2" x 1" metal case which matches the Apple. Each of the two paddles is connected with a long 5-foot cable to the Apple paddle socket.

Every component in a set of Super Paddles is the very finest quality available. The set is backed by a 90-day limited warranty from the manufacturer as well as Peripherals Plus' moneyback guarantee of satisfaction.

To order, send $39.95 plus $2.00 postage and handling (NJ residents add $2.00 sales tax) to the address below. Credit card customers may call orders to our toll-free number.

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CIRCLE 239 ON READER SERVICE CARD

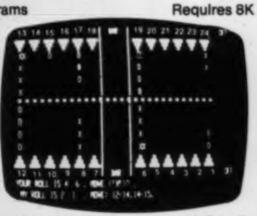
TRS-80 sensational software

creative computing software

Board Games

Cassette CS-3001 $11.95 6 Programs Requires 8K

Qubic. A 3-dimensional tic-tac-toe type of game played in a 4x4x4 cube. A real challenge.



Backgammon. (by Scott Adams). Excellent graphics and challenging play in this popular game.

Flip Disc. Our version of Othello with three skill levels from good to expert.

Mugwump. Four friendly Mugwumps are hiding on a 10x10 grid. Can you find them all in ten moves?

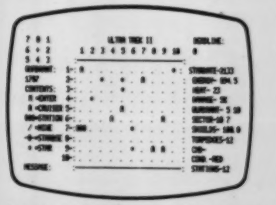
Wumpus. Try to find the Wumpus in a dodecahedron network of caves complete with bottomless pits and giant bats.

Wumpus 2. Five different types of caves or create your own. More hazards too.

Space Games

Cassette CS-3002 $11.95 4 Programs Requires 8K

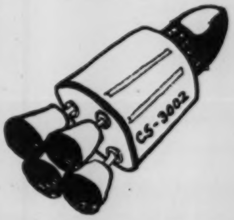
Star Lanes. The ultimate game of intergalactic commerce and trade for earthbound entrepreneurs.



Ultra Trek. Battle klingons with lasers, torpedoes and mines in this real-time game with action graphics.

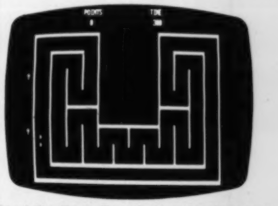
Romulan. Use your sensors to find the hidden Romulan spacecraft and then destroy it.

Star Wars. Line up the TIE fighters in your sights and zap them. It's not easy.

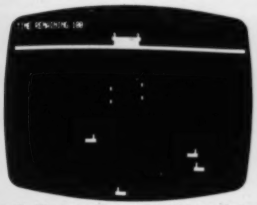


Pursuit Games

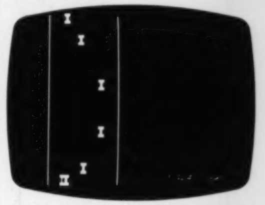
Cassette CS-3004 $11.95 5 Programs Requires 16K



Stock Car Race. Real-time road racing game around a complex track. Don't blow your engine.



Depth Charge. Move your ship and drop charges to destroy as many subs as possible.



Indy Racer. Real-time with gear changing similar to the popular arcade game.

Maze. Nine skill levels in this high-speed pursuit game.

Kaleidoscope. A ever-changing graphics demonstration.

Strategy Games

Cassette CS-3005 $11.95 5 Programs Requires 16K

Evasion. Try to escape from the snake. It's not easy.

Motor Racing. Real-time racing action and excellent graphics with your choice of tracks.

TUNNEL VISION

Tunnel Vision. Find your way out of a maze given only a mouse-eye view.

Jigsaw. Use reasoning and luck to fit your pieces into the puzzle.

The Masters. Choose your club and go from tee to green on each hole.

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Games Pack on Disk

Disks CS-3503 (32K) $39.95

This set of menu-driven disk contains all 20 games from cassettes CS-3001, CS-3002 CS-3004 and CS-3005.

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CIRCLE 300 ON READER SERVICE CARD

Special editions for Apple, Atari and TRS-80 Computers.

Programming is Child's Play

Hey kids, are the folks out of the room? Good, 'cause I've got a secret to tell you. You know that computer they fuss over? Well, kid, between you and me, this whole programming thing is a lot simpler than they realize.

What's that? Sure, you can learn. Just get a copy of **Computers For Kids.** It's a super book, and it tells you everything you need to know. Huh? You have an Apple? No problem. There's a version just for the Apple. One for the TRS-80 and one for the Atari too, with complete instructions for operating and programming.

The book will take you through everything programmers learn. Its easy to understand and the large type makes it easy to read. You'll find out how to put together a flowchart, and how to get your computer to do what you want it to do. There's a lot to learn, but **Computers For Kids** has 12 chapters full of information. You'll even learn how to write your own games and draw pictures that move.

Just so the folks and your teachers won't feel left out, there's a special section for them. It gives detailed lesson ideas and tells them how to fix a lot of the small problems that might pop up. Hey, this book is just right for you. But you don't have to take my word on that. Just listen to what these top educators have to say about it:

Donald T. Piele, Professor of Mathematics at the University of Wisconsin-Parkside says, "**Computers For Kids** is the best material available for introducing students to their new computer. It is a perfect tool for teachers who are learning about computers and programming *with* their students. Highly recommended."

Robert Taylor, Director of the Program in Computing and Education at Teachers College, Columbia University states, "it's a good idea to have a book *for children*."

Not bad, huh? Okay, you can let the adults back in the room. Don't forget to tell them **Computers For Kids** by Sally Greenwood Larsen cost only $3.95. And tell them you might share it with them, if they're good. Specify edition on your order: TRS-80 (12H); Apple (12G); Atari (12J).

Your local computer shop should carry **Computers For Kids**. If they don't ask them to get it or order by mail. Send $3.95 payment plus $2.00 for one, $3.00 for two or more for shipping and handling to Creative Computing Press, P.O. Box 789-M, Morristown, NJ 07960.

creative computing press

CIRCLE 350 ON READER SERVICE CARD

ATARI 800 SOFTWARE!!

TRS-80 EXTENDED BASIC COLOR COMPUTER SOFTWARE

TRS-80 POCKET COMPUTER SOFTWARE!!

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ATARI 800 16K min. 40K Preferred. >GRAPHICS EDITOR''''< NOW, both 2-D and 3-D scenes can be designed with a JOYSTICK, and then saved to disk'''' These scenes can then be loaded in later to be edited before you save it again under another name'' All of this can be done using ANY graphics mode''' But that's not all''' You can save entire screens OR just individual images in 2-D OR 3-D'' You have the option of giving the new scenes different file names, a MENU of disk files is shown on the screen as you choose the file name. A 'HELP' option is included should you have trouble with ANY operation. If you decide to use the 3-D option, you may change the 3-D view(s) of the object(s) on the screen. Uses Player-Missile Graphics for the 'cursor'. POWERFUL, AND WELL DOCUMENTED'' Disk version is recommended (--add $5.00--). W/5 Programs. ONLY $29.95 +$1.50 p&h. on Cassette.

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TRS-80 POCKET COMPUTER >WUMPUS ADVENTURE'< Now you can play our popular WUMPUS game on your P.C. With A 4 page manual and listing, on cassette--$7.95 +.95 p&h Pay by Check or Money Order (preffered).Foriegn-U.S.funds ONLY.CAL.6% sales.tax

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Words For The Wise - 5 activities plus 1000 words or you can make your own words. (TRS-80 Lev. 11, 16K $24.95)

Earth Science Series - for Jr. and Sr. High School (12 programs - TRS-80 Lev. 11, 16K, $68.50)

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CIRCLE 314 ON READER SERVICE CARD

New Products, continued...

costs-to-date; and preparation of financial reports. It will run on the TRS-80 Model III, TI 99/4, and Apple II or III. $94.95. Charles Mann & Associates, Micro Software Division, 55722 Santa Fe Trail, Yucca Valley, CA 92284. (714) 365-9718.

CIRCLE 377 ON READER SERVICE CARD

MUSIC AND GRAPHICS

Color Board is a color graphics package for Apple computers which allows users to create, erase, change, store, and retrieve graphics. The high resolution system offers six colors and allows drawings to be combined with alphanumerics in several sizes and upper and lower case. It also provides for automatic generation of arcs, circles, squares, rectangles, ellipses, triangles, and other shapes. $60. Software Technology for Computers, P.O. Box 428, Belmont, MA 02178. (617) 923-4334.

CIRCLE 378 ON READER SERVICE CARD

Computer Station has introduced software drivers that allow the user to dump the contents of high resolution pages out to either the Centronics 739 or the Epson MX-80 printers to obtain hard copy graphics. $44.95. Also available is a plotting program designed to take full advantage of the high resolution capabilities of the IDS Paper Tiger 460G/560G printers. The program writes to disk and dumps from disk to printer without being restricted to the 280 x 192 resolution of the Apple hi-res page. $49.95. Computer Station, 11610 Page Service Dr., St. Louis, MO 63141. (314) 432-7019.

CIRCLE 379 ON READER SERVICE CARD

AppleGraphics II is a programming tool which enables Apple users to view a multi-dimensional object from any angle. The package is designed to help software OEMs and software developers prepare computer programs which require two- and three-dimensional graphics. System requirements are a 48K Apple II or Apple II Plus with the language system and disk drive. $95. Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95014.

CIRCLE 380 ON READER SERVICE CARD

Cromemco has announced **Slidemaster**, a graphics system which can be used to display color or black-and-white images with up to 756 x 482 point resolution on a high quality RGB monitor. Used with any Cromemco computer with graphics capability and a digitizing tablet, the package facilitates the development of graphics for business statistics and charts, art and illustration, and other professional applications. It is available on 5 1/4" or 8" disk. $595. Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94043. (415) 964-7400.

CIRCLE 381 ON READER SERVICE CARD

VENDOR LITERATURE

CATALOG OF EDUCATIONAL PROGRAMS

Marck's catalog lists a wide variety of tested educational software programs and related products for the Apple II, Atari, PET and TRS-80.

Titles are listed by computer and indexed by subject area. Programs cover all age levels and include all traditional subject areas. $4.95.

Marck, 2890 Linden Ave., Branford, CT 06405.

EDUCATIONAL SOFTWARE CATALOG

K-12 MicroMedia announces a catalog containing descriptions of over 300 programs and books for microcomputer-based learning. It is free, upon request, to educators.

Organized by subject and grade level, each entry includes program name, type, functional description, memory requirements and indication of availablity for the Apple, PET, and/or TRS-80.

K-12 MicroMedia, P.O. Box 17, Valley Cottage, NY 10989.

OFFICE MANAGEMENT SOFTWARE CATALOG

Charles Mann & Associates, Micro Software Division, has announced a soft-

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★ W/CONT. + 3.3	590.00
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★ MICROPRO WORD STAR	249.95
MICROSOFT Z-80 CARD	259.95
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COMPU - MATH: DECIMALS	32.95
COMPU - SPELL (REQ. DATA DISK)	24.95
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New Products, continued...

ware catalog featuring office management applications for Apple II, Apple II Plus, Apple III, TRS-80 Model I and Model III and TI 99/4 computers.

The catalog includes a variety of professional and personal text processing systems, mailing list management systems, small accounting and payroll systems, asset management systems and personnel records systems.

Charles Mann & Associates, Micro Software Division, 55722 Santa Fe Trail, Yucca Valley, CA 92284. (714) 356-9718.

FREE OASIS SOFTWARE DIRECTORY

Listing over 200 application software packages designed for the Oasis operating system, a free two-color *Software Monitor* newsletter has been published by Phase One Systems.

With a cross-reference chart to different application areas such as accounting, word processing, manufacturing control, and medical/dental packages, the Oasis Application Software Directory listings also include contact names for immediate action regarding questions. Both national and international software sources are provided.

Phase One Systems, 7700 Edgewater Dr., Suite 830, Oakland, CA 94621. (415) 562-8085.

CP/M SOFTWARE INDEX

The second edition of the Small Systems Group's *CP/M Software Index* has been published. The Index lists 740 programs which are offered by 248 software vendors.

The Index is organized into five major areas: systems software, general applications, accounting applications, utility applications and industry specific software. These are broken down into 76 categories. Examples of the categories are word processors (27 entries), integrated accounting packages (29 entries), higher level language processors (55 entries) and medical packages (14 entries). The names, addresses and phone numbers of the vendors of the programs are also listed. $6.

Small Systems Group, Box 5429, Santa Monica, CA 90405. (213) 392-1234.

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J.L. Hammett Company announces an educational courseware catalog for elementary and secondary schools. The catalog includes reviewed software in computer literacy, math, language arts, basic programming, administrative needs and more.

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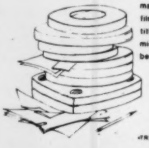

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BPILOT 3.0 is a Z80 assembly language program for the Model I TRS-80®, Level II (16K+) or disk (32K+). Send $39.95 + $2.00 S&H (Calif. resd. add 6% sales tax). Reference manual alone $7.95 (credited toward future purchase).

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CIRCLE 258 ON READER SERVICE CARD

Educational Excellence

Excellent educational software is the exception rather than the rule.

Excellence in educational software. It's not easily achieved.

Many large publishers have entered the computer software business. Many have flopped. Why? Because producing good software is not the same as producing a textbook.

Tough Criteria

Good educational software must meet specific objectives in the teaching/learing process. It must motivate and hold the attention of the students. It must not bore the gifted students nor be over the heads of slower students. It must be "user friendly" to both the teacher and student. And it must be accompanied by clear documentation, worksheets and all the material necessary to use it effectively.

A tall order.

But one which MECC has met.

The Minnesota Educational Computer Consortium (MEEC) was founded in 1973 with the goal of extending the benefits of computers to every school in the state. Over the years, MECC has developed procedures for finding and perfecting programs from contributors throughout the state.

Few Programs Qualify

Before a program is accepted for the MECC library it is judged on ten specific criteria. For example:

1) Accuracy ... Is all spelling and grammer correct? Does each question provide for a correct and appropriate response?

2) Audience ... Is the intended audience (grade level and subject) served by the degree of difficulty and scope of the program? Is the reading level of the text material suitable?

3) Clarity ... Are explanations and instructions sufficient, clear and straight forward? Is the presentation well-formatted?

4) Graphics ... Are the graphics appropriate and sufficient in quantity?

Other criteria include documentation, function, programming, and the like. Similar criteria are applied to the documentation. This insures that the reading level is appropriate, that objectives are well-stated and that associated materials are available.

What this all means is that the educational software packages from MECC are among the best available anywhere. They are pedigogically sound, throroughly tested and well documented.

Now the MECC software library is available to both schools and individuals through Creative Computing Software.

MECC software is currently available only on disk for the Apple II. All disks run under DOS 3.2 and require a minimum of 48K memory and Applesoft in ROM or an Apple II Plus.

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To order any MECC software package, send payment plus $2.00 postage and handling to the address below. To charge an order to Visa, MasterCard or American Express include card number and expiration date. Charge orders may also be called in to our toll-free number. School purchase orders should add an additional $2.00 billing fee.

Order MECC software today for the highest quality and best value in educational software available anywhere.

These disks are protected in 3.2 DOS, no copying or muffining can be done.

Apple Demonstration Diskette
MECC-701, $19.95

A sample of the different kinds of applications available on the MECC diskettes is shown. The software demonstrates applications in drill and practice, tutorial, simulation, problem solving, and worksheet generation. Samples from music, science, social studies, industrial arts, reading and mathematics are provided.

Elementary—Volume 1 (Mathematics)
MECC-702, $24.95

The first elementary diskette contains programs to be used in the elementary mathematics classroom. Games of logic such as BAGELS, TAXMAN, and NUMBER, drill and practice programs, such as SPEED DRILL, ROUND, and CHANGE, and programs about the metric system such as METRIC ESTIMATE, METRIC LENGTH, and METRIC 21 are included on the diskette.

Elementary—Volume 2 (Language Arts)
MECC-703, $24.95 (Available 7/81)

The teacher can enter lists of spelling words in the computer and have them used by the program SPELL, which drills students on the spelling, MIXUP which presents the word in mixed up order, or WORD FIND, which will create a word find puzzle for the teacher to duplicate. If words and definitions are entered, a CROSS WORD puzzle can be generated or a WORD GAME can be played. Two other programs included on this diskette are TALK, a program designed to introduce students to the computer or AMAZING which prints out worksheet mazes. Several programs on this diskette use a printer.

Elementary—Volume 3 (Social Studies)
MECC-704, $24.95 (Available 7/81)

The sell series, SELL APPLES, SELL PLANTS, SELL LEMONADE, and SELL BICYCLES which appears on the ELEMENTARY VOLUME 3 diskette can be used to teach elementary economics to students in grades 3-6. CIVIL will reinact battles of the CIVIL war while STATES and STATES2 provide drill and practice on the location of states in the U.S. and their capitals.

Elementary—Volume 4 (Mathematics And Science)
MECC-705, $24.95

Two mathematics programs ESTIMATE and MATHGAME provide reinforcement on estimating and basic facts. Food chains in fish can be studied through ODELL LAKE while ODELL WOODS deals with food chains in animals. SOLAR DISTANCE teaches the concepts or distances in space and URSA provides a tutorial on constellations.

Elementary—Volume 5 (Language Arts)
MECC-719, $24.94 (Aailable 7/81)

ELEMENTARY—VOLUME 5 deals with the reading concept of prefixes. The diskette contains five lessons which both teach the prefixes of UN, RE, DIS, PRE, and IN. Two review drils, DRAGON FIRE and PRE-APP II, are also contained on the diskette.

Elementary—Volume 6
MECC-725, $24.95 (Available 7/81)

Historical simulations, OREGON, VOYAGEUR and FURS are included in the ELEMENTARY—VOLUME 6 diskette. Along with these programs are NOMAD which teaches map reading and SUMER.

Special Needs—Volume 1 (Spelling)
MECC-727, $24.95 (Available 7/81)

This diskette is designed to drill handicapped students on frequently misspelled primary and intermediate words. Students answer problems by either using the game buttons, the game paddles or any key on the keyboard.

Science—Volume 2 (Senior High)
MECC-709, $24.95 (Available 7/81)

Many of the programs on this diskette were developed by Minnesota teachers. PEST, which deals with the use of pesticides, and CELL MEMBRANE which the user takes the part of a cell membrane, can be used in biology classes. SNELL plots light refraction demonstrating SNELL's law while COLLIDE simulates the collision between two bodies. DIFFUSION deals with the diffusion rates of various gasses, NUCLEAR SIMULATION shows radioactive decay of nine different radioisotopes, ICBM and RADAR teach angles and projections on a coordinate system.

Science—Volume 3 (Middle School)
MECC-707, $24.95 (Available 7/81)

The FISH program through the use of low resolution graphics show the circulatory system of a fish. Simulations like ODELL LAKE which is used to explore food chains, URSA which teaches about constellations, and QUAKES which simulates earthquakes are on the diskette. MINERALS can be used in the area of earth science to identify 29 minerals by having students perform simple tests.

Mathematics—Volume 1 (Senior High)
MECC-706, $24.95 (Available 7/81)

BAGELS, SNARK, ICBM, and RADAR will teach students logic while reinforcing the concepts of plotting prints or angle measurements ALEGBRA provides a drill and practice in solving equations. Three programs on the diskette can be used in plotting equations on a grid: SLOPE which is designed for use in ninth grade with linear functions, POLYGRAPH which will plot any equation on a rectangular coordinate system, and POLAR which graphs functions on polar coordinates.

Aestheometry—Volume 1
MECC-716, $24.95 (Available 7/81)

AESTHEOMETRY deals with the topic of curve sketching by introducing and demonstrating the "space concepts" of elliptical, parabolic and hyberbolic curves. Curve sketching designs are developed to provide an aesthetic view of geometric shapes.

Teacher Utilites—Volume 1
MECC-715, $24.95 (Available 7/81)

The TEACHER UTILITIES diskette is designed to aid the teacher and would not be used by the student unless the teacher creates questions using the REVIEW program. This program allows the teacher to set up a list of questions which can be used either by the REVIEW program or the TEST GENERATOR program. The teacher can also make CROSS WORD puzzles, WORD FIND puzzles, BLOCK LETTER banners and POSTERS using this program. FREQUENCY and PERCENT can be used to calculate grades and to do statistical analysis. A printer is needed for some of the programs on this diskette.

Programmer's Aid—Volume 1
MECC-720, $32.95 (Available 7/81)

The PROGRAMMER's AID diskette provides help for the programmer. Programs to be able to UPLOAD and DOWNLOAD to the MECC system, programs that work with text files including FP TO TEXT, RANDOM EDITOR, SEQUENTIAL EDITOR, and TEXT LIST along with programs to work with binary files, BINARY FILE INFO, BINARY FILE TO FP are included. Two programs TABLES and MERGE allow the user to create, change and merge graphic shapes for use in a program. FREE SPACE will tell the amount of space on the diskette while HIDDEN CHARACTERS will locate contol character. STARTER will put standard routines such as space bar, music, graphic characters or input into a user's program which is just being created or already created.

MICAS—Volume 1
MECC-721, $32.95 (Available 7/81)

Microcomputer Integrated Computerized Accounting System requires dual disks and 132 characters width printer. The MICAS computerized accounting system provides a realistic experence with automated accounting systems. The package consists of four integrated systems: (1) general ledger, (2) accounts payable, (3) accounts receivable, and (4) inventory control.

Shape Tables—Volume 1
MECC-724, $24.95 (Available 7/81)

The SHAPE TABLES diskette includes 12 files of 187 shapes that can be incorporated in a user's program. Also included are aids needed to work with shape tables.

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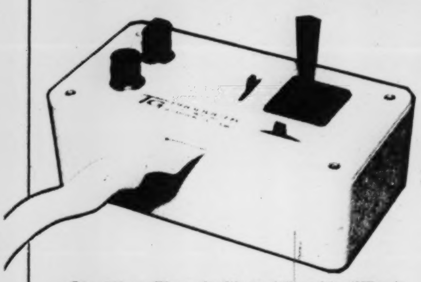


Super Joystick

Star Wars. Played with paddles, it's difficult at best and frustrating at worst. But with a joystick it becomes an entirely new experience. It's still challenging. It's also fun. And very addictive.

Have you ever used a drawing program in which one paddle controls the horizontal movement of the "brush" and the other paddle the vertical? It's slow, tedious work. But with a joystick, drawing is an absolute joy.

Exceptional Precision

The Apple high-resolution screen is divided into a matrix of 160 by 280 pixels. To do precise work on this screen, you need a precise device. Most potentiometers used in paddle controls are not quite linear. If you rotate a paddle control at a constant speed, you'll notice that the cursor speeds up slightly at the beginning and end of the paddle rotation.

The Super Joystick has a pure resistive circuit which is absolutely linear within one tenth of one percent. In other words it would give you precise control over an image of 1000 by 1000 pixels, were such resolution available. Thus it is suitable for high precision professional applications as well as educational and hobbyist ones.

Matched to your application

The Super Joystick also has two external trim adjustments, one for each direction. This allows you to perfectly match the unit to your application and computer. Say you want to work in a square area instead of the rectangular screen. Just reduce the horizontal size with the trim control.

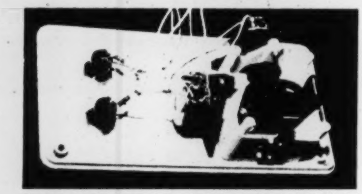
How many times have you played Space Invader and had your thumb ache for hours from the repeated button pressing? This won't happen with the Super Joystick. It's two pushbuttons are big. Moreover, they use massive contact surfaces with a life of well over 1,000,000 contacts. A few games of Super Invader using these big buttons will justify the purchase of the Super Joystick.

The Super Joystick is self-centering in both directions. That means when you take your hand off it, the control will return to the center. However, if you want it to stay where you leave it, self-centering may be easily disabled.

The Super Joystick plugs right into the paddle control socket and doesn't require an I/O slot.

High-quality construction

The sturdy metal case of the Super Joystick matches that of the Apple computer. Every component used is the very highest quality available. The Super Joystick even uses a full 16-conductor ribbon cable so you can add a second joystick if you wish. The first Super Joystick replaces Paddles 0 and 1. You may not realize it, but the Apple can support four paddle controls. A second Super Joystick would replace Paddles 2 and 3.



By removing two springs, self-centering can be defeated.

We invite your comparison of the Super Joystick with any other unit available. Order it and use it for 30 days. If you're not completely satisfied, return it for a prompt and courteous refund plus your return postage. You can't lose.

The Super Joystick consists of a self-centering, linear joystick, two trim controls, and two pushbuttons mounted in an attractive case. It comes complete with an instruction booklet and 90-day limited warranty. Cost is $59.95.

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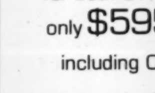

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New Products, continued...

CATALOG OF CP/M SOFTWARE

A reference catalog describing CP/M compatible application software and the companies who write and distribute it is now available from Digital Research, Inc.

The catalog lists more than 100 companies that write CP/M compatible software. Application programs are cross-referenced by application type, including programs for word processing, accounting, utilities, languages and vertical markets. $5.

Digital Research, P.O. Box 579, 801 Lighthouse Ave., Pacific Grove, CA 93950. (408) 649-3896.

MICROSOFT CATALOGS

Microsoft Consumer Products announces two new catalogs.

One catalog provides detailed information about software packages, their applications and system requirements.

The other is designed as a handy guide with capsulized descriptions of each Microsoft product and its specifications.

Both books are available through Microsoft dealers or directly from Microsoft Consumer Products, 400 108th Ave. NE, Suite 200, Bellevue, WA 98004.

MONUMENT SOFTWARE CATALOG

Monument Computer Service has announced the release of its free Summer-Fall Software Catalog, which features products for the Apple III computer.

The catalog provides detailed descriptions of more than 50 business, word processing, educational, and personal applications for the Apple Computer family.

Monument Computer Service, Village Data Center, P.O. Box 603, Joshua Tree, CA 92252. (800) 854-0561, ext. 802. In California, (800) 432-7257.

MAGAZINES, NEWSLETTERS

GRAPHICS NEWSLETTER

"The Computer Graphics Software News" is a newsletter which will review computer programs in both the public and industrial domains which specifically deal with computer generated graphics.

Areas of coverage include CAD/CAM, animation, business graphics, image processing and petrophysical related software.

"The Computer Graphics Software News" will be published six times per year at a subscription rate of $50 per year.

"The Computer Graphics Software News," 5857 S. Gessner, Suite 401, Houston, TX 77036. (713) 975-8509.

NEWSLETTER FOR PHYSICIANS

A new publication from Information Research, the "Physician's Desktop Computer Letter" provides the physician and his staff with up-to-date information on the applications of desktop computer hardware and software, plus tutorials and check lists for use in the clinic and general practice.

A subscription is $68 per year for eleven issues.

Information Research, 10367 Paw Paw Lake Dr., Mattawan, MI 49071.

GENEALOGY NEWSLETTER

"Genealogical Computing is a newsletter for genealogists and home computerists.

The newsletter features a directory of genealogy-oriented programs for personal computers, columns on how to computerize your family research records, program reviews, and interchanges among those using their computers for genealogical purposes.

"Genealogical Computing" is edited by Paul and Saralou Andereck, operators of the Family Historians' Forum, a computerized genealogical message system. A subscription is $12 for six issues.

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OO-Topos	D	32.95	25.95
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ASCII Exp 3.2-3.3	D	79.95	63.95
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Speed Star		134.95	107.95
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E-Z Draw 3.0	D	49.95	39.95
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SOFTWARE PUBLISHING CO.			
PFS Per Filing Sys.	D	95.00	75.95
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UNITED SOFTWARE OF AMERICA			
Appleworld	D	59.95	47.95
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CIRCLE 158 ON READER SERVICE CARD

New Products, continued...

EDUCATIONAL SOFTWARE LIBRARY

Educational Software Library Inc. is a nonprofit organization which offers a mail order library of educational programs for the TRS-80 Models I and III.

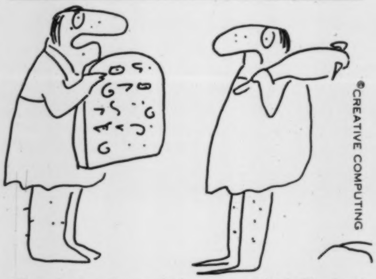
ESL publishes a bimonthly newsletter giving descriptions of available software, ranging from preschool to high school level.

A $20 one-year membership entitles the member to the newsletter, two free educational tapes, the opportunity to borrow programs for two week periods for $2 per tape, and the opportunity to purchase software at discount prices.

Educational Software Library, 262 Park Lane, King of Prussia, PA 19406.

SCHOOL MICROWARE REVIEWS

The first issue of *School Microware Reviews* will contain user evaluations of over 100 instructional programs and packages for the Apple, PET, and TRS-80, as well as an index to evaluations in many other publications.



"Developing the symbols wasn't so bad. The hard part was that the line-printer kept jamming."

The book will be organized by subject within school departments. Each evaluation includes a summary rating which is backed up with extensive comments (both positive and negative) about the quality of the program. $30 per edition.

Dresden Associates, P.O. Box 246, Dept. CCNR, Dresden, ME 04342. (207) 737-4466.

COMPUTERS IN SCIENCE TEACHING

The Journal of Computers in Science Teaching is published quarterly by the Association for Computers in Science Teaching.

It includes descriptions of uses of computers in science instruction, tutorials, reports of research studies, lists and reviews of software, announcements of conferences and events, bibliographies of articles in the field, and book reviews. A one-year subscription is $7.

Association for Computers in Science Teaching, P.O. Box 4825, Austin, TX 78765.

BOARD GAMES MAGAZINE

Schema is a new magazine "devoted to the diversity of board games."

The bi-monthly magazine is published by Michael Waitsman, and a one-year subscription is $15.

Schema, 100 E. Ohio St., Ste. 226, Chicago, IL 60611.

MISCELLANEOUS

PMC-80 NETWORK SYSTEM

Personal Micro Computer, Inc., has introduced a system for local network distribution of data or programs. Principal applications for the Downloader System are for teaching and distributing information to local displays.

The system is comprised of a master disk-based PMC-80 with 48K byte memory and several slave PMC-80s. The slaves are 16K byte memory units equipped with the company's Fastload modification which accepts data serially from the master at 10,000 bits per second.

The master PMC-80 has a Downloader interface (Model DLR-50) on an S-100 bus card which plugs into the Expander chassis.

The master with 48K memory and two disk drives is priced under $3000. Each slave with 16K memory is priced under $1000.

Personal Micro Computers, Inc., 475 Ellis St., Mountain View, CA 94043. (415) 962-0220.

CIRCLE 382 ON READER SERVICE CARD

FREE

business software directory

- Radio Shack's Model-I, II, III.
- Heath's MBASIC and HDOS.
- CPM

Data base manager, integrated accounting package, inventory, word processing, and advanced mailing list.

Micro Architect Inc.
96 Dothan St.
Arlington, MA 02174

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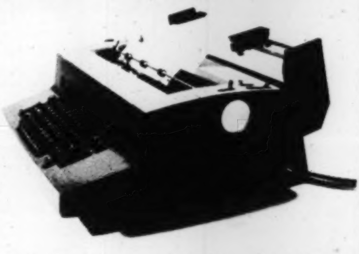

McAnn Co. has announced the Model 16 Fanfold Feeder which allows the use of continuous forms with IBM Selectric and other ofice typewriters or printer units.

The feeder installs by slipping under the typewriter base, and no electrical or mechanical connections are required. The adjustable-width tractors accept form widths up to 16.5" between guide holes, and can be used with single or multiple part forms. $149.95.

McAnn Co., P.O. Box 3173, San Mateo, CA 94403. (415) 349-1229.

CIRCLE 383 ON READER SERVICE CARD

BOOT BUTTON FOR APPLE

The Boot Button allows an Apple user who has upgraded to 3.3 DOS (16-Sector) to boot a disk in 3.2 DOS (13-Sector) with the push of a button.

The add-on board fits onto the Disk II controller card. Directions are provided for placing the proper PROM in the proper socket. The user plugs both P5 and P5A PROMS into the Boot Button and plugs the board into the controller card.

Computer Station, 11610 Page Service Dr., St. Louis, MO 63141. (314) 432-7019.

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computer store of the month

Computerland of Nassau

Numerous computer stores sell Creative Computing Magazine, Press, and Software. In this issue we are spotlighting Computerland of Nassau. We would like to recognize their salesmanship, success and service to the community.

Computerland of Nassau does not nestle comfortably on an island in the Bahamas as many expect, but is on Long Island in the heart of Nassau County just 20 miles east of Manhattan. It boasts an in-stock product inventory of over 2000 items of which more than 50% are programs, books and magazines. The store carries a full line of Creative Computing products. Computerland of Nassau is a supermarket for businessmen, educators, professionals, and hobbyists alike. The store is alive with displays of Apple, Atari, Commodore, Dynabyte, Ithaca Intersystems, Osborne, Vector Graphics equipment.

Computerland of Nassau, a franchise of Computerland Corp. of San Leandro, California, opened for business in late 1978 and was staffed with the owner, Elliot Greene, his wife Sydell, and their soon to be son-in-law, Keith Bub. The store's 2400 square feet of retail space is a veritable Grand Central Station of activity. Four full-time technicians cater to customer's servicing needs both in the store and in the field. Eight salespeople assure customers of prompt and courteous service. Behind the scenes, two administrative people utilize their own computers to control the accounting and management information needs.

The store is located at 79 Westbury Ave. in Carle Place, L.I., N.Y. 11514. Their phone number is 516-742-2262. If you are ever in the area, stop in and see them.

New Products, continued...

HOME CONTROL FOR TRS-80

Radio Shack has introduced a device that permits direct computer control of up to 256 line-powered lights and appliances: the TRS-80 Plug 'n Power Controller (26-1182).

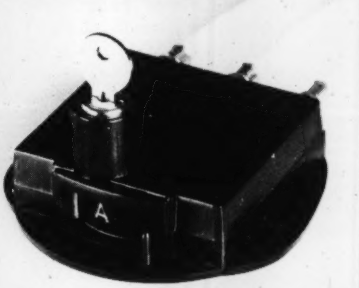
The TRS-80 Plug 'n Power Controller connects to the cassette output of any TRS-80 Model I, Model III or Color Computer. It translates instructions from the host TRS-80 computer into controlling signals, which are coupled through normal AC power wiring to remote appliance and lamp dimmer modules (sold separately).

Any one of up to 256 remote modules can be reached with a command to turn on, turn off, brighten or dim a light, or to turn an appliance off. Alternatively, a group of up to 16 remote modules can be turned on or off together, and up to sixteen such groups are accessible. $39.95.

Available at Radio Shack stores and Computer Centers.

CIRCLE 385 ON READER SERVICE CARD

TV LOCKING SYSTEM

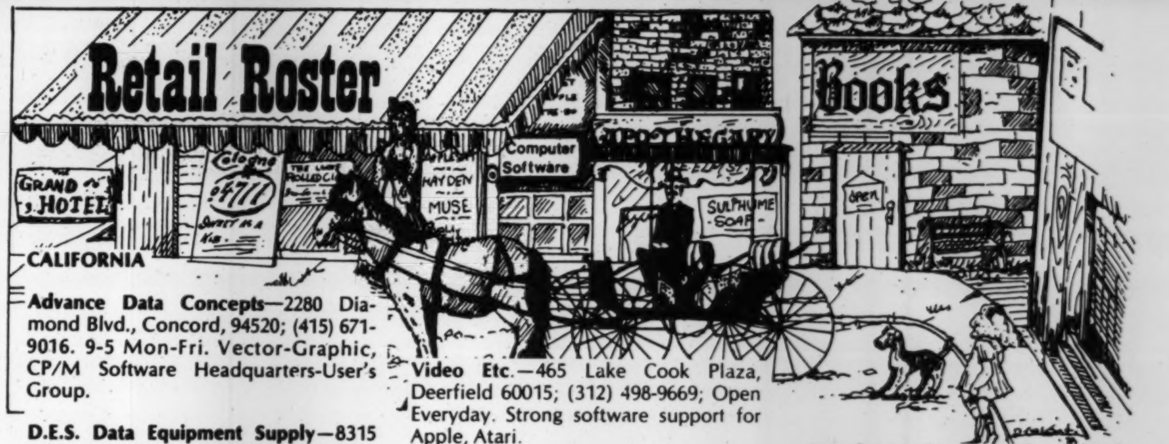


Permo announces Video Lock, selective locking system that permits parental control over either standard, pay television, or video cassette recorder viewing.

The Permo Video Lock is an A/B locking switch made of coated-cast metal. It has specially treated contact points for long wear. It comes complete with cable and security shields so that the connecting ends of the cable connot be removed and the lock by-passed. $24.95.

Permo, 3001 Malmo Rd., Arlington Heights, IL 60005. (312) 640-2472.

CIRCLE 386 ON READER SERVICE CARD



CALIFORNIA

Advance Data Concepts—2280 Diamond Blvd., Concord, 94520; (415) 671-9016. 9-5 Mon-Fri. Vector-Graphic, CP/M Software Headquarters-User's Group.

D.E.S. Data Equipment Supply—8315 Firestone, Downey 90241. (213) 923-9361 7 days. Commodore PET specialists. Hardware Software, Books, Mags, Supplies, In House Maintenance.

CONNECTICUT

Computerworks—1439 Post Rd., East Westport 06880; (203) 255-9096. 12-6 Tues-Fri, 12-9 Thu, 10-5 Sat.

GEORGIA

Atlanta Computer Mart—5091 Buford Hwy, Atlanta 30340; (404) 455-0647. 10-6 Mon-Sat

ILLINOIS

Computer Land/Downers Grove—136 Ogden Ave., Downers Plaza 60515; (312) 964-7762. 10-6 Mon.-Sat., 10-8 Tue., Thurs. Apple, Atari, Osborne Zerox, Vector.

Data Domain of Schaumburg—1612 E. Algonquin Rd., Schaumburg 60195; (312) 397-8700. 12-9 Tues-Fri, 11-5 Sat. Apple, Alpha Micro, Hewlett-Packard Calculators. Largest book and magazine selection.

Farnsworth Computer Center—1891 N. Farnsworth Ave., Aurora, IL 60505; (312)851-3888. 10-8 Mon-Fri, 10-5 Sat. Apple, Hewlett-Packard series 80 systems, HP Calculators, IDS Printers.

Gavin Computers—5935 W. Addison St., Chicago; (312) 286-4232. Mon.-Thurs. 9-8:30, Tues.-Sat. 9-6. Apple B & H, Atari & Commodore Systems.

Lillipute Computer Mart, Inc.—4446 Oakton, Skokie 60076; (312) 674-1383. M-F 10:30-8 pm, Sat 10-6. We sell Cromemco, Gimix, Bell & Howell, NorthStar and others. Starting our fifth year in business.

To include your store in Creative Computing's *Retail Roster, call the Advertising Department at (201) 540-9168*

Video Etc.—465 Lake Cook Plaza, Deerfield 60015; (312) 498-9669; Open Everyday. Strong software support for Apple, Atari.

The Video Station—872 So. Milwaukee Ave., Libertyville; (312) 367-8600. Open 7 days. Atari Computers, Hardware and Software.

MASSACHUSETTS

Neeco—679 Highland Ave, Needham 02194; (617) 449-1760. 9-5:30 Mon-Fri. Commodore, Apple, Superbrain, Atari

Science Fantasy Bookstore—18 Eliot St., Harvard Sq., Cambridge 02138; (617)547-5917. 11-5 Mon-Sat, 11-8 Thur. Apple & TRS-80 games; Epyx, Microsoft, Creative Computing.

MICHIGAN

Upstate Computer Shop—629 French Rd., Campus Plaza, New Hartford 13413; (315) 733-9139; Mon—Fri 10—6, Sat 11—5. Apple—Commodore—Data General.

Computer Center—Garden City; (313) 425-2470 & West Bloomfield; (313)855-4220; Books, Magazines, Hardware and Software for Apple, Northstar, TRS-80 & PET.

NEVADA

Home Computers—1775 E. Tropicana #6, Las Vegas 89109 (702) 798-1022. 10-7 Mon-Sat. Apple, Commodore, Atari, AIM 65, (Books) Sales & Service.

NEW JERSEY

Computernook—Rt. 46, Pine Brook Plaza, Pine Brook 07058; (201) 575-9468. 10-6:30 MTWS, 10-8 Thurs., Fri. Apple/Commodore Authorized dealer.

Silent Partner —2050 Center Ave., Fort Lee 07024; (201) 947-9400; Mon-Sat 10-6. Apple/Atari/Commodore/Vector/Malibu.

Stonehenge Computer Shop—89 Summit Avenue, Summit 07901; (201) 277-1020. 10 am - 6:30 pm Mon-Sat. Apple/Bell & Howell/Commodore Authorized Dealer, Sales and Service.

Software City—111 Grand Ave., River Edge 07661; (201) 342-8788. Bus/Rec/Utility Home programs for TRS-80, Atari, Apple and PET. 10-25% off list.

NEW YORK

Programs Unlimited—20 Jericho Turnpike, Jericho, NY 11753; (516)333-2266. 10-8 Mon-Sat. The largest microcomputer software selection available.

The Computer Center—31 East 31st St., New York 10016; (212)889-8130. 10-7 Mon-Fri, 11-6 Sat, 10-8 Thur.

Upstate Computer Shop—629 French Rd., Campus Plaza, New Hartford 13413; (315)733-9139. 10-6 Mon-Fri, 11-5 Sat. Apple—Commodore—Data General.

OHIO

Abacus II—1417 Bernath Pkwy., Toledo 43615; (419) 865-1009.

Micro Mini Computer World—74 Robinwood Ave., Columbus 43213; (614) 235-5813/6058. 11-7 Tues-Sat. Authorized Apple/Commodore dealer. Sales, Service, Business Software.

North Coast Computers—626 Dover Center, Bay Village 44140; (216)835-4345. 10-6 Mon-Sat, 10-8 Tue, Thur. Apple/Atari/Vector Graphic/Data General.

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Petted—4265 W. Loom's Rd. (I-894-Hwy 36, Milwaukee 53221; (414)282-4181. 12-8 Mon-Fri, 10-4 Sat. Authorized Commodore PET, CBM, VIC dealer. Books, Magazines, Chips, etc.

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puzzle answers

A Wild West Problem: DEAL, MEAL, MEAT, MOAT, BOAT, BOOT, BOON, SOON, SOOT, SHOT.

A Money Problem: $106.52

$$\begin{array}{r} 9567 \\ +1085 \\ \hline 10652 \end{array}$$

Which Is Which: John is the golfplayer and the barber. Dick is the trumpeter and the smuggler. Roger is the computer technician and the truckdriver.

The Talking Machine: 11 men — $55.00. 19 Women — $38.00. 70 Children — $7.00. Total 100 persons at $100.00.

Dog's Mead: Mrs. Goosby is 86 years old.

^{1}3	8	^{2}7	^{3}2	0	▨	^{4}1
5	▨	^{5}3	2	▨	^{6}4	4
5	▨	9	▨	^{7}3	5	2
▨	^{8}1	6	^{9}1	0	▨	▨
^{10}7	2	▨	^{11}1	9	^{12}1	^{13}3
9	▨	▨	▨	^{14}7	9	2
^{15}2	7	▨	^{16}1	6	▨	5

A Roman Problem:

$$\frac{XIX}{VII} \neq 11$$

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101	102	103	104	105	251	252	253	254	255
106	107	108	109	110	256	257	258	259	260
111	112	113	114	115	261	262	263	264	265
116	117	118	119	120	266	267	268	269	270
121	122	123	124	125	271	272	273	274	275
126	127	128	129	130	276	277	278	279	280
131	132	133	134	135	281	282	283	284	285
136	137	138	139	140	286	287	288	289	290
141	142	143	144	145	291	292	293	294	295
146	147	148	149	150	296	297	298	299	300
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156	157	158	159	160	306	307	308	309	310
161	162	163	164	165	311	312	313	314	315
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236	237	238	239	240	386	387	388	389	390
241	242	243	244	245	391	392	393	394	395
246	247	248	249	250	396	397	398	399	400

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101	102	103	104	105	251	252	253	254	255
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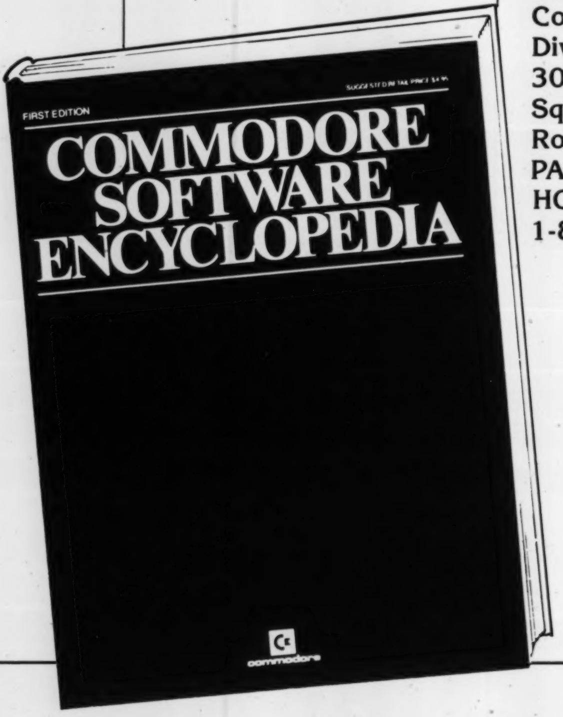
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